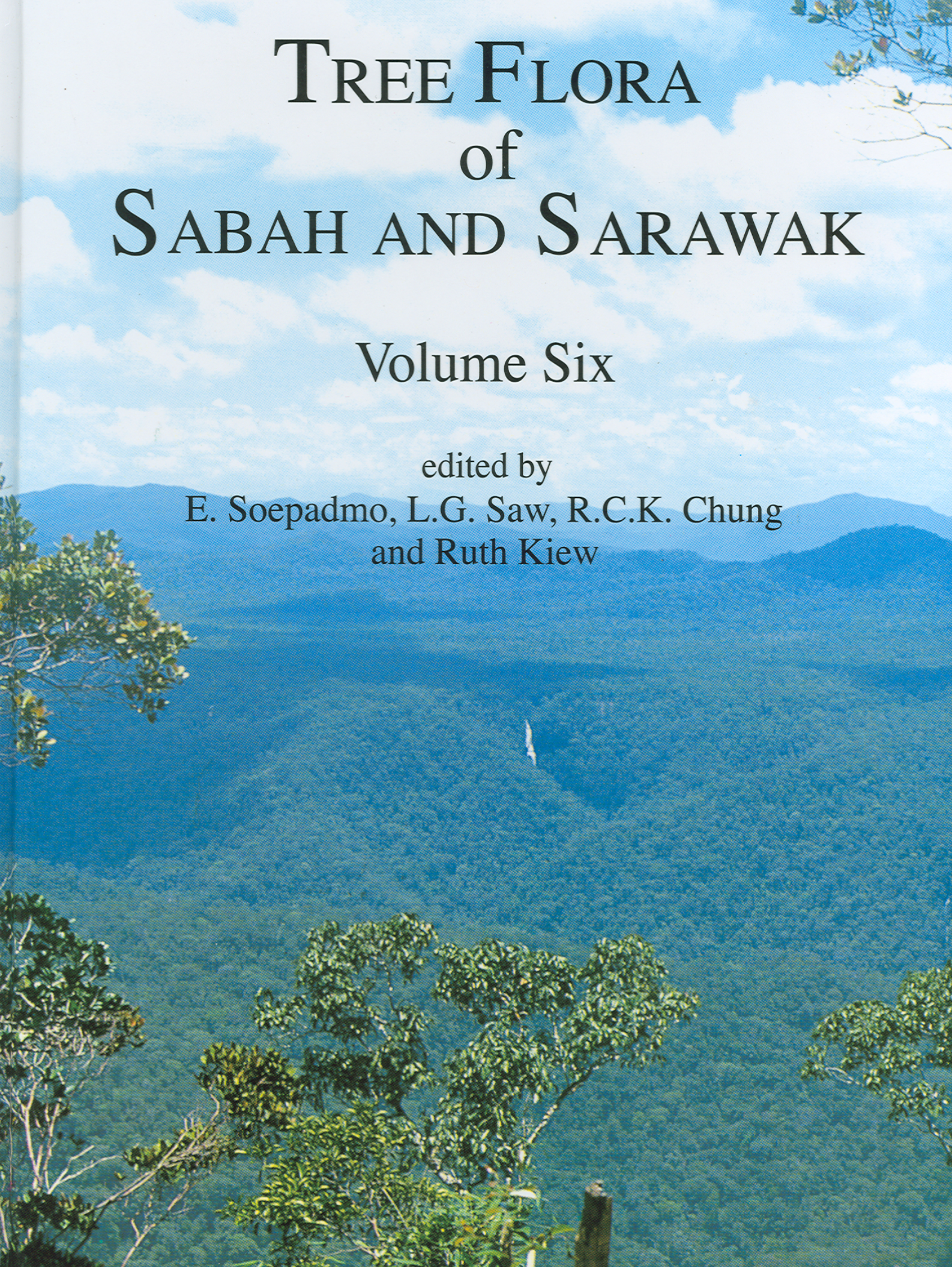


TREE FLORA of SABAH AND SARAWAK

Volume Six

edited by
E. Soepadmo, L.G. Saw, R.C.K. Chung
and Ruth Kiew



TREE FLORA
of
SABAH AND SARAWAK

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Front cover: Lowland and hill forests on ultramafic soil, Bt. Tawai FR, Sabah. (Photograph
by E. Soepadmo.)

Back cover: *Koompassia excelsa* (Becc.) Taub. with new growth. (Photograph by E.
Soepadmo.)

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FOREWORD

Once again we are delighted to write a few words welcoming the publication of Volume 6 of the Tree Flora of Sabah and Sarawak. We are also pleased that the project continues to be on track by the publication of this volume just about two years after Volume 5. This volume treats four families, namely the Cunoniaceae (R.C.K. Chung), Hernandiaceae (L.G. Saw), Meliaceae (David J. Mabberley, Caroline M. Pannell, Anne M. Sing, and Jennifer M. Edmonds), and Polygalaceae (W.J.J.O. de Wilde and Brigitta E.E. Duyfjes), comprising 180 tree species in 18 genera native to Sabah and Sarawak. Of the 180 species, 72 are endemic in Sabah and Sarawak (or Borneo), 22 taxa (species, subspecies and varieties) are new to science (published elsewhere), 98 species reach timber size (with a dbh of 30 cm or larger), and 10 species produce edible fruits (e.g. species of *Aglaia*, *Lansium* and *Sandoricum*). Ecologically, members of the Meliaceae and Polygalaceae are important constituents of the under storey and main canopy layers of tropical rain forest in Borneo, and play an important role in providing natural habitats and a food source for many species of wildlife. In addition, the timber of many species described in this volume is locally important for house construction, boat-building and handicraft work. The publication of Volume 6 of the Tree Flora of Sabah and Sarawak marks a further milestone for us towards achieving the overall objectives of documenting the tree species richness of Sabah and Sarawak.

For a long-term project, such as the Tree Flora of Sabah and Sarawak, it is difficult to sustain the momentum and progress without adequate funding and full commitment and dedication by all involved in the project. In this context, we would like to acknowledge the full support and financial assistance provided by the Ministry of Science, Technology and Innovation (MOSTI) of Malaysia.

We are also very much obliged to the Curators, Keepers and Directors of the: Herbarium of the Arnold Arboretum, Harvard University, U.S.A.; Herbarium Bogoriense, Bogor, Indonesia; Herbarium of the Royal Botanic Gardens, Edinburgh, U.K.; Herbarium of the Royal Botanic Gardens, Kew, U.K.; National Herbarium of the Netherlands, University of Leiden Branch, Netherlands; Herbarium of the Missouri Botanic Gardens, U.S.A.; Herbarium of the New York Botanic Gardens, U.S.A.; Daubeny Herbarium of the University of Oxford, U.K.; Herbarium of the Singapore Botanic Gardens, Singapore; Herbarium of the Botany Department, Smithsonian Institution,

Washington D.C., U.S.A.; and Herbarium of the Sabah Parks, Sabah, Malaysia. Their collaboration and continual support has been instrumental to the success of the project.

Finally, we would like to congratulate and record our sincere appreciation to the botanists, members of the editorial committee, botanical artists and supporting staff of the three leading Malaysian forestry institutions directly involved in the project for their dedication and hard work in producing Volume 6 of the Tree Flora of Sabah and Sarawak.

Dato' Dr. Hj. Abdul Razak Mohd. Ali

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October 2006

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E. Soepadmo
L.G. Saw
R.C.K. Chung
Ruth Kiew

October 2006

CUNONIACEAE

R. C. K. Chung

Forest Research Institute Malaysia,
Kepong, Malaysia

R. Br. *in* Flinders, Voy. Terra Austral. 2 (1814) 548; Miquel, Fl. Ned. Ind. 1, 1 (1856) 717; Merrill, EB (1921) 287; Masamune, EPB (1942) 324; Hutchinson, Fam. Fl. Pl. 2nd. edition 1 (1959) 158, Gen. Fl. Pl. 2 (1967) 4; Backer & Bakhuizen *f.*, FJ 1 (1964) 506; Keng, OFMSP rev. edition (1978) 56; Whitmore, TFM 1 (1972) 179; Cockburn, TS 2 (1980) 26; Corner, WSTM 3rd. edition 1 (1988) 224; Whitmore, Tantra & Sutisna, CLK 1 (1990) 52; Turner, Gard. Bull. Sing. 47 (1995) 182; Coode *et al.* (eds.), CLBD (1996) 64; Beaman *et al.*, PMK 4 (2001) 213; Bradford & Barnes, Syst. Bot. 26, 2 (2001) 354; Hopkins & Hoogland, FM 1, 16 (2002) 53; Bradford *et al. in* Kubitzki (ed.), Fam. Gen. Vasc. Pl. 6 (2004) 91.

Trees or shrubs. **Twigs** almost flat or angular when young, becoming terete with lenticels and longitudinal fissures when older. **Indumentum** of simple hairs. **Stipules** *interpetiolar*, one pair per node between petiole bases, triangular to ovate or almost orbicular, sometimes bifurcate to deeply divided at apex. **Leaves** *opposite and decussate*, *imparipinnate*, *trifoliolate* or *unifoliolate*, usually petiolate. **Leaflets** *pinnately veined*, *margin crenate to serrate or entire*. **Inflorescences** axillary or terminal, paniculate, thyrsoïd or racemose with a straight peduncle, or capitate. **Flowers** radially symmetrical, occasionally protandrous, bisexual or unisexual (plants dioecious or polygamo-dioecious); sepals 3–6(–9), usually 4 or 5, imbricate, free or basally connate; petals as many as sepals, alternate with them; stamens usually twice as many as sepals, alternipetalous ones often slightly longer than alternisepalous stamens, *filaments usually slender and longer than petals*, anthers dorsifixed, versatile, opening longitudinally; disc free, annular or composed of segments, rarely adnate to the ovary, or absent; ovary superior, (2–)3–5(–14)-carpellate, syncarpous, each carpel with its own free style, styles often diverging and ending in a small inconspicuous stigma, or rarely with decurrent stigmas, ovules (1–)2–many in each locule, often in two rows, placentation axile to pendulous. **Fruits** dehiscent, *capsular*, usually small. **Seeds** small, glabrous or hairy; endosperm starchy.

Distribution. About 27 genera, with *c.* 300 species. Mostly native to the southern hemisphere (especially in Australia, New Guinea, and New Caledonia), but extending into the tropics in C America, W Indies, S Pacific, and throughout Malesia (absent in N America, Europe, mainland Asia north of Peninsular Malaysia and continental Africa except South Africa). About 40 species in 10 genera in Malesia, only three species in one genus (*Weinmannia*) in Sabah and Sarawak.

Ecology. In Sabah and Sarawak, species of Cunoniaceae are found in mixed dipterocarp forest to upper montane forest between (500–)1000 and 2600 m. In Sabah, *Weinmannia fraxinea* can be found in habitats on poor sandy soils at altitude as low as 500 m. In Sulawesi, flowers of *W. furfuracea* H.C.Hopkins are visited by bees, while in Borneo (Mt. Kinabalu) beetles and flies were observed visiting flowers of *W. fraxinea*.

Uses. The timber of *Weinmannia* species (mostly *W. fraxinea*) is used for construction purposes or for utility furniture and house interiors but on a local scale only. In Ambon (Maluku), the bark of *W. fraxinea* is dried and stored in bundles and used to colour sago-porridge during cooking or to improve the flavour of old sago (Heyne, Nuttige Pl. Indonesia 3rd. edition (1950)).

Taxonomy. Bentham & Hooker (Gen. Pl. 1 (1865) 653), King (J. As. Soc. Beng. 66, 1 (1897) 297) and Ridley (FMP 1 (1922) 681) included Cunoniaceae (*Weinmannia*) in Saxifragaceae but most subsequent authors (e.g., Backer & Bakhuizen *f. op. cit.*, Keng *op. cit.*, Whitmore *op. cit.*, Turner *op. cit.*, Beaman *et al. op. cit.*, and Hopkins & Hoogland *op. cit.*) accepted this family as distinct. The recent classification of the angiosperms based on molecular sequence data places Cunoniaceae in the order Oxalidales (Eurosids I), together with Brunelliaceae, Cephalotaceae, Connaraceae, Elaeocarpaceae (including Tremandraceae) and Oxalidaceae (APG, Ann. Missouri Bot. Gard. 85 (1998) 531, Bot. J. Linn. Soc. 141 (2003) 399; APG website, 20 September 2006).

Bradford & Barnes (Syst. Bot. (2001) 354), based on their phylogenetic analyses of Cunoniaceae, recognised six tribes (*Caldcluvieae*, *Codieae*, *Cunonieae*, *Geissoieae*, *Schizomerieae* and *Spiraeanthemeae*). This new tribal classification shows that *Weinmannia* together with *Cunonia*, *Pancheria* and *Vesselowskyia* (all in tribe *Cunonieae*) are parts of a derived clade, characterised by the racemose/capitate inflorescence, capsular fruit with a single vertical column bearing the seeds and the tricolporate pollen.

WEINMANNIA L., *nom. cons.*

(Johann Wilhelm Weinmann, 1683–1741; German pharmacist and botanist)

tekarau (Kelabit)

Syst. Nat. 10th. edition 2 (1759) 997, 1005, 1367; Bentham & Hooker *f.*, Gen. Pl. 1 (1865) 653; King, J. As. Soc. Beng. 66, 1 (1897) 298 (under Saxifragaceae); Ridley, FMP 1 (1922) 682 (under Saxifragaceae); Masamune, EPB (1942) 324; Bernardi, Candollea 17 (1961) 123, Candollea 18 (1963) 285, Adansonia 2, 3 (1963) 404, Bot. Jahrb. Syst. 83 (1964) 126; Backer & Bakhuizen *f.*, FJ 1 (1964) 506; Hutchinson, Gen. Fl. Pl. 2 (1967) 9; Whitmore, TFM 1 (1972) 179; Anderson, CLTS (1980) 165; Cockburn, TS 2 (1980) 26; Corner, WSTM 3rd. edition 1 (1988) 224; Whitmore, Tantra & Sutisna, CLK 1 (1990) 52; Turner, Gard. Bull. Sing. 47 (1995) 182; Corner *in* Wong & Phillipps (eds.), Kinabalu Summit Borneo (1996) 129; Coode *et al.* (eds.), CLBD (1996) 64; Bradford, Ann. Missouri Bot. Gard. 85 (1998) 565; PROSEA 5, 3 (1998) 580; Hopkins, Adansonia 3, 20 (1998) 18; Beaman *et al.*, PMK 4 (2001) 213; Hopkins & Hoogland, FM 1, 16 (2002) 141; Bradford *et al. in* Kubitzki (ed.), Fam. Gen. Vasc. Pl. 6 (2004) 108. **Synonym:** *Pterophylla* D.Don, Edinburgh New Philos. J. 9 (1830) 93.

Trees or shrubs. Branching not dichotomous. **Twigs** sometimes slightly thickened or flattened at nodes, often with prominent pale lenticels. **Stipules** elliptic, ovate, orbicular to subreniform, often caducous and leaving a prominent annular scar at the node; in young shoots, a pair of opposite stipules often salverform and amplexicaul. Terminal and lateral vegetative buds enclosed by a pair of bud scales (stipules). **Leaves** with 1–13 pairs of sessile or subsessile, opposite lateral leaflets or rarely unifoliate; petiole and rachis sometimes winged; leaflets chartaceous to coriaceous, glabrous or sparsely to densely pubescent, lateral ones often with an unequal base, frequently smaller than the terminal leaflets; domatia absent; blades with or without multicellular trichome bases, *margin toothed or crenulate*. **Inflorescences** composed of *racemes arranged in groups of two*

(diads) or four (tetrads) born on a sterile axis (= peduncle), which is either axillary and often inserted in series at distal node(s), or terminal, or a combination of these; individual racemes with up to 100 or more flowers. **Flowers** unisexual or bisexual, pedicellate, 4-merous; buds inserted singly or in small fascicles, each bud or fascicle subtended by a carinate, often caducous bract; calyx lobes 4, aestivation imbricate; petals 4, usually elliptic, ovate or obovate, base constricted, apex rounded or irregularly emarginate, membranous, often ciliolate; stamens twice as many as calyx lobes, filaments filiform, anthers broadly cordate, deeply incised at base and apiculate at apex; disc divided into 8 free lobes alternating with the filaments, each lobe oblong to obcuneate, sometimes broadly oblong with flanges on either side, usually glabrous; gynoecium 2-carpellate, with the carpels fused at the level of ovary; ovary ovoid, 2-locular, styles 2, free, subulate, glabrous, furrowed on adaxial side, stigmas terminal, small or sometimes capitate and papillose, ovules 8–16 per locule. **Fruits** septifragal capsules dehiscing from the apex; free central column often present; valves coriaceous, boat-shaped, with a dark exocarp and smooth, yellow endocarp with extended margins; styles usually persistent; calyx lobes persistent or not. **Seeds** elliptic in outline and circular in transverse section, minutely sculptured, usually with a tuft of hairs at each end or sometimes hairy all over (outside Borneo).

Distribution. About 150–160 species in Latin America, W Indies, S Pacific and throughout Malasia. Seventeen species in Malasia; three species in Sabah and Sarawak, of which one species, *Weinmannia clemensiae*, is endemic in Borneo.

Ecology. In mixed peat swamp, kerangas, mixed dipterocarp to upper montane forests at about (0–)500–2600 m altitude.

Uses. The wood is reported to be suitable for house-building (poles and beams), utility furniture and interior construction. The bark contains high levels of tannin and it was used medicinally in Java (Burkill, EPMP 2 (1966) 2295; PROSEA *op. cit.*).

Taxonomy. Bernandi (*op. cit.* 1961, *op. cit.* 1963, *op. cit.* 1964) divided *Weinmannia* into six sections, viz. sect. *Fasciculatae* Bernandi, sect. *Inspersae* Bernandi, sect. *racemosa* Bernandi, sect. *Simplicifoliae* Bernandi, sect. *Spicatae* Bernandi, and sect. *Weinmannia*. However, Bradford (*op. cit.*) and Bradford *et al.* (*op. cit.*), using a cladistic analysis based on morphology and inflorescence architecture, concluded that the genus is best segregated into five sections, viz. sect. *Fasciculatae* Bernandi ex Hoogland & H.C.Hopkins, sect. *Inspersae* Bernandi ex J.C.Bradford, sect. *Leiospermum* (D.Don) Engl., sect. *Spicatae* Bernandi ex J.C.Bradford, and sect. *Weinmannia* (incl. sect. *Simplicifoliae* Bernandi). In Sabah and Sarawak, all three species belong to sect. *Fasciculatae*.

Key to *Weinmannia* species

1. Lateral leaflets elliptic or almost oblong, largest ones $1.4\text{--}2.7 \times 0.5\text{--}1$ cm, bullate, margins strongly recurved; young shoots tomentose-velutinous.....**2. W. clemensiae**
Lateral leaflets lanceolate, narrowly elliptic, narrowly obovate to ovate, largest ones $(2.2\text{--})4.2\text{--}8.5\text{--}(12) \times (0.8\text{--})1.2\text{--}3.5\text{--}(4.5)$ cm, margins flat or slightly recurved; young shoots almost glabrous, puberulent or tomentose.....2
2. Leaves with (0–)1–4(–5) pairs of lateral leaflets; rachis semiterete, sometimes narrowly winged; lateral leaflets coriaceous, narrowly elliptic to narrowly obovate, base cuneate,

apex acute to obtuse, drying chesnut-brown. Inflorescence of 1–2 pairs of opposite dyads.....**1. W. aphanoneura**
 Leaves with 1–8 pairs of lateral leaflets; rachis terete, not winged; lateral leaflets chartaceous to subcoriaceous, lanceolate to ovate, or narrowly elliptic, base usually unequal and varying from cuneate to rounded, apex narrowly acute to acuminate, usually drying greenish brown. Inflorescence of 1–3 pairs of opposite dyads or tetrads.
**3. W. fraxinea**

1. *Weinmannia aphanoneura* Airy Shaw

Fig. 1

(Greek, *aphanes* = inconspicuous, *neuron* = nerve; leaflets with inconspicuous lateral and intercostal veins)

Bull. Misc. Inform., Kew (1940) 260; Bernardi *op. cit.* (1964) 160; Anderson *op. cit.* 165; Whitmore, Tantra & Sutisna *op. cit.* 52; Hopkins *op. cit.* 35; Beaman *et al. op. cit.* 213; Hopkins & Hoogland *op. cit.* 145. **Type:** *Richards 1716*, Borneo, Sarawak, Miri Division, Marudi District, Dulit Ridge (holotype K [photo at KEP])

Tree or shrub, 2–20 m tall, to 35 cm diameter. **Bark** dark brown, scaly; inner bark brownish. **Sapwood** pale yellow. **Twigs** *adpressed puberulent or glabrescent when young*, becoming glabrous with numerous lenticels and prominent leaf scars when older. **Stipules** often persistent at distal nodes, suborbicular, usually flat, to 1.7 × 1.9 cm (rarely spatulate, *c.* 0.6 × 0.4 cm), abaxial surface glabrous or strigose towards the base, adaxial surface glabrous. **Leaves** with (0–)1–4(–5) *pairs of lateral leaflets*, to 16 cm long; *petiole and rachis semiterete*, flat, slightly ridged or channelled above, *sometimes narrowly winged*, wings extending to 1 mm on either side of midline, glabrous or tomentose; petioles 0.7–2.8 cm long; rachis segments between pairs of leaflets 0.5–1.9 cm long; *leaflets coriaceous, not bullate, margin flat or slightly recurved*, crenate, with 6–11 notches on each side of the largest lateral leaflets, glabrous except for some hairs on midrib below, sometimes shiny above, *drying chestnut below, grey or dark chestnut above*; lateral leaflets almost sessile, drying chesnut-brown, *narrowly elliptic or narrowly obovate, largest 2.4–7 × 0.6–1.9 cm, base cuneate*, unequal, *apex acute to obtuse*; terminal leaflets narrowly elliptic to obovate, 3–9.4 × 0.7–2.7 cm, base narrowly cuneate to attenuate, apex acute to obtuse; midrib prominent below, slightly sunken above; lateral and intercostal veins flat on both surfaces; petiolules of 0.3–1.2 cm long. **Inflorescences** *usually of 1 or 2 pairs of opposite dyads*; peduncles 0.3–1.9 cm long, glabrous or adpressed puberulent; individual racemes 7–8(–14) cm long, axes puberulent, rarely tomentose. **Flowers** unisexual; pedicels 1.8–3.6 mm long, puberulous; calyx lobes 0.5–0.8 × 0.4–0.9 mm, glabrous; petals oblong or irregularly obovate, 1.2–1.5 × 0.7–0.8 mm, apex rounded or emarginate; disc lobes 0.3–0.5 mm long, oblong and discrete or with thin flanges forming an almost continuous disc. **Male flowers:** filaments 2.1–2.6 mm long, pistillodes 0.5–0.7 mm long, pubescent, styles 0.1–0.2 mm long, incurved. **Female flowers:** staminodes to 1.7 mm long; ovary *c.* 1 mm long, densely pubescent, styles *c.* 1.8 mm long, straight. **Fruit** valves 2.5–3.5 × 1.3–1.5 mm at dehiscence; exocarp pubescent; calyx lobes persistent. **Seeds** *c.* 0.9 mm long, with a tuft of hairs at both ends.

Distribution. Sumatra (one record; *Nagamasu 3641, n.v.*) and Borneo (Sabah, Sarawak and Kalimantan). In Sabah, rare and known only from Mt. Kinabalu (e.g., *Clemens 29476* and *SAN 76507*). In Sarawak, common and recorded from Bintulu (e.g., *S 8785*), Marudi (e.g., *Chew CWL 380, CWL 388* and *S 4507*) and Limbang districts (e.g., *Burt & Martin B 5487, S 26481* and *S 26531*). Also occurs in Kalimantan (e.g., *Endert 4125*).

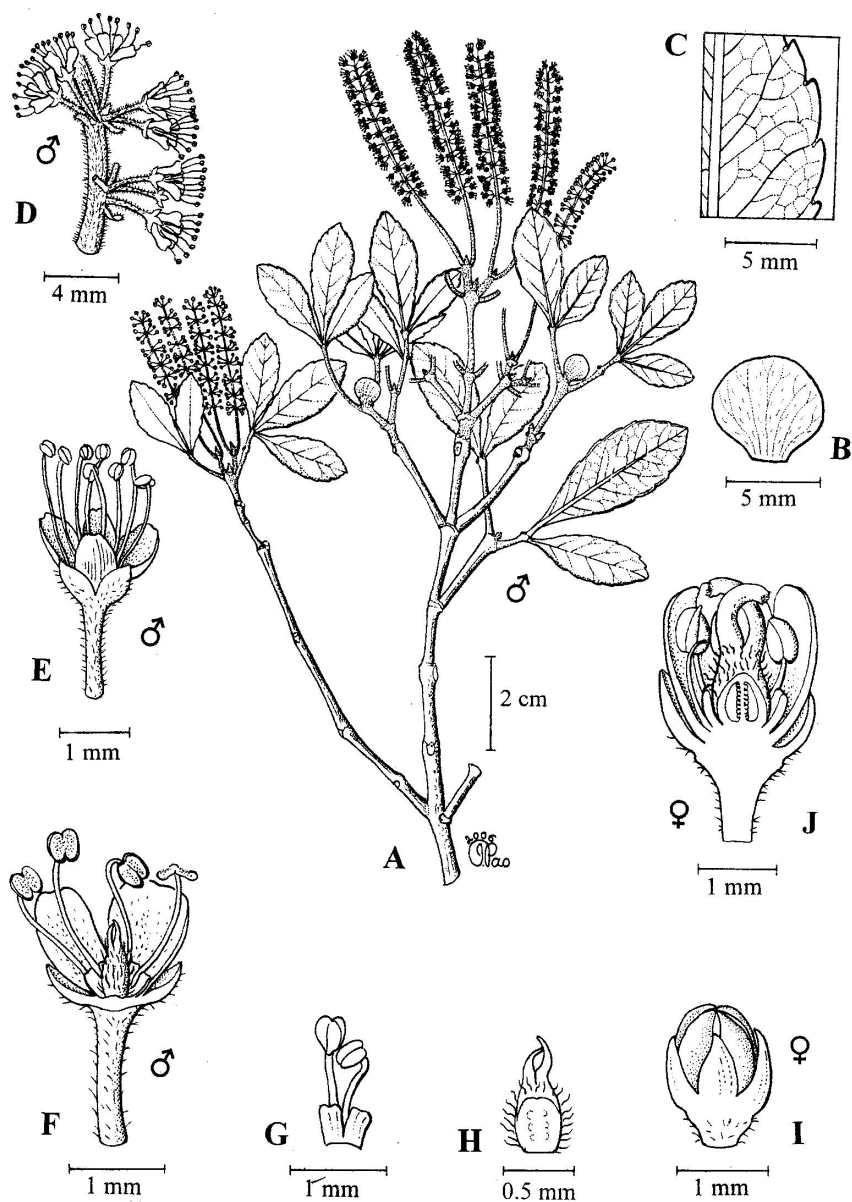


Fig. 1. *Weinmannia aphanoneura*. A, flowering (male) leafy twigs; B, stipule; C, detail venation on lower leaf surface; D, section of rachis of raceme showing male flowers inserted in fascicles; E, open male flower; F, open male flower with two sepals and two petals removed; G, two disk lobes and two stamens; H, longitudinal section of pistillode in staminate flower; I, female flower bud; J, longitudinal section of female flower. (A–H from S 8785, I–J from Burt & Martin B 5487.)

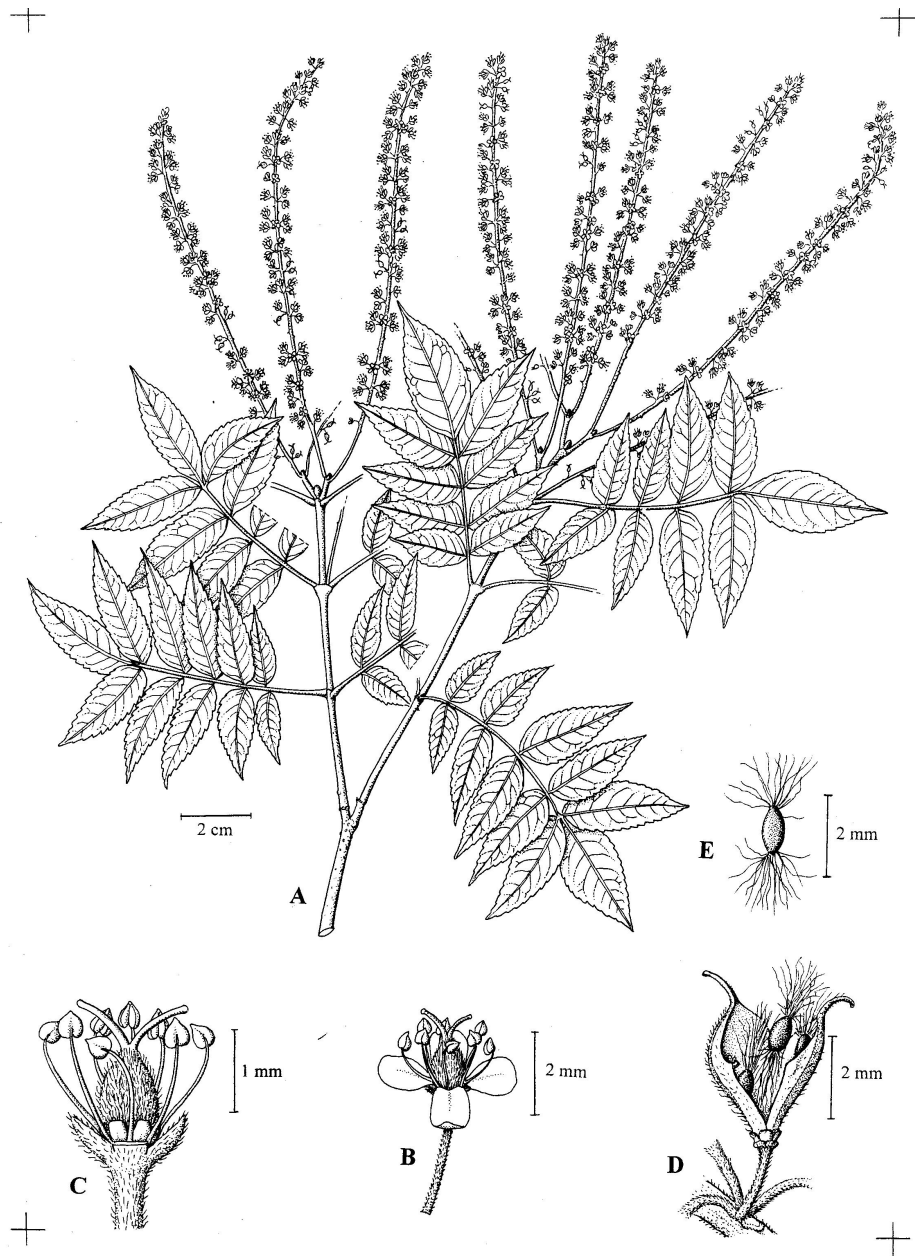


Fig. 2. *Weinmannia fraxinea*. A, flowering (female) leafy twigs; B, female flower; C, female flower with one sepal and four petals removed; D, dehiscent capsule; E, seed. (A and C from Nooteboom & Chai 1696, B from SAN 56254, D-E from SAN 84928.)

Ecology. Lower to upper montane forest and *kerangas* forest, at 1175–2560 m altitude.

2. *Weinmannia clemensiae* Steenis

(Mary Strong Clemens, 1873–1968, prolific plant collector in W Java, Borneo, the Philippines and Papua New Guinea)

J. Bot. 72 (1934) 3; Masamune *op. cit.* 324; Bernardi *op. cit.* (1964) 166; Cockburn in Luping *et al.* (eds.), Kinabalu Summit Borneo (1978) 185, *op. cit.* (1980) 28; Whitmore, Tantra & Sutisna *op. cit.* 52; Hopkins *op. cit.* 32; Beaman *et al. op. cit.* 213; Hopkins & Hoogland *op. cit.* 146. **Type:** *Clemens 27880*, Borneo, Sabah, Mt. Kinabalu, near Kamborangah (holotype BO; isotypes K [photo at KEP], L).

Treelet or small tree, 1.5–10 m tall. **Twigs** (young) *densely tomentose-velutinous*. **Stipules** usually caducous, almost orbicular, to 1×1.2 cm, abaxial surface densely sericeous towards the base, adaxial surface velutinous. **Leaves** with 6–13 pairs of lateral leaflets, to 13 cm long; petiole and rachis terete, not winged, densely tomentose-velutinous; petioles 0.5–1 cm long; rachis segments between pairs of leaflets 0.4–0.9 cm long; *leaflets* coriaceous, *bullate*, *margin strongly recurved and often rolled*, usually obscurely crenate with 5–7 notches on each side of the largest lateral leaflets, sparsely to densely pubescent below, puberulent above or glabrous; midrib sericeous; lateral leaflets sessile, inserted almost at 90° to the rachis, *elliptic or almost oblong*, *largest* $1.4\text{--}2.7 \times 0.6\text{--}1$ cm, proximal leaflets smaller, base rounded to cordate, symmetrical, apex broadly acute; terminal leaflet elliptic, $1.9\text{--}3.3 \times 0.7\text{--}1$ cm, base rounded to rarely cordate, apex acute; midrib prominent below, sunken above; lateral veins almost at 90° angle to midrib, prominent below; intercostal venation obscure; petiolules of 0.3–0.5 cm long. **Inflorescence** of 1 pair of opposite dyads; peduncles 0.3–0.7 cm long, densely tomentose-velutinous; individual racemes to 10.5 cm long, axes densely tomentose-velutinous. **Flowers** unisexual (or sometimes ?bisexual); pedicels 1–1.5 mm long, with short erect hairs; calyx lobes $0.8\text{--}0.9 \times 0.6\text{--}0.8$ mm, hirsute; petals obovate to almost orbicular, $1.1\text{--}1.5 \times 1\text{--}1.1$ mm, apex rounded; disc lobes oblong or broadly oblong, 0.4–0.5 mm long. **Male flowers:** filaments *c.* 2.5 mm long, pistillodes *c.* 0.6 mm long, densely pubescent, styles 0.1 mm long, incurved. **Female flowers:** staminodes to 1.9 mm long; ovary 1.5–2 mm long, densely pubescent, styles *c.* 1 mm long, straight, pubescent at base. **Fruit** valves $3.7\text{--}4.5 \times 1.8\text{--}2.2$ mm at dehiscence; exocarp densely pubescent; calyx lobes persistent. **Seeds** (immature) *c.* 0.9 mm long, with tuft of hairs at both ends.

Distribution. Endemic in Borneo and confined to Mt. Kinabalu and Mt. Tambuyukon in Sabah (e.g., *Barkman & Buin 141*, *Chew & Corner RSNB 4364*, *RSNB 4508*, *RSNB 4755*, *SAN 28737*, *SAN 34617*, *SAN 47041*, *SAN 48098*, *SNP 2318*, *SNP 3675*, *SNP 4896*, and *SNP 12066*). Probably all populations occur within the boundary of Kinabalu Park, whose protection is therefore crucial to the continued survival of this species.

Ecology. Restricted to dwarf upper montane forest with a rather open canopy on ultramafic soils, at (1640–)1900–2600 m altitude.

Notes. This species has characteristically elliptic or almost oblong and bullate leaflets with the margins recurved so that they cannot be flattened and dense tomentose-velutinous twigs.

3. *Weinmannia fraxinea* (D. Don) Miq.

Fig. 2

(Latin, *fraxinus* = ash tree (*Fraxinus* L. of the family Oleaceae); with leaflets resembling those of the ash tree)

Fl. Ned. Ind. 1, 1 (1856) 718; Bernardi *op. cit.* (1964) 167; Hopkins *op. cit.* 23; Beaman *et al. op. cit.* 214; Hopkins & Hoogland *op. cit.* 151. **Basionym:** *Pterophylla fraxinea* D. Don, Edinb. New Philos. J. 9 (1830) 93. **Type:** *Smith s.n.*, Maluku, Honimoa (holotype LINN-SM). **Synonyms:** *Weinmannia blumei* Planch., Lond. J. Bot. 6 (1847) 470, King, J. As. Soc. Beng. 66, 1 (1897) 299, Merrill, EB (1921) 287, Ridley, FMP 1 (1922) 682, Masamune *op. cit.* 324, Backer & Bakhuizen *f. op. cit.* 506, Bernardi *op. cit.* (1964) 161, Anderson *op. cit.* 165, Whitmore *op. cit.* 179, Cockburn *op. cit.* 26, Corner *op. cit.* 224, Whitmore, Tantra & Sutisna *op. cit.* 52, Turner *op. cit.* 182, PROSEA 5, 3 (1998) 580; *W. blumei* Planch. var. *major* Ridl., FMP 5 (1925) 307; *W. borneensis* Engl., Nat. Pflanzenfam., ed. 2, 18a (1930) 256, Airy Shaw *op. cit.* 260, Bernardi *op. cit.* (1964) 164, Whitmore, Tantra & Sutisna *op. cit.* 52, Coode *et al. (eds.) op. cit.* 64; *W. dulitensis* Airy Shaw *op. cit.* 259, Anderson *op. cit.* 165.

Tree to 25(–40) m tall with small thick buttresses. **Bark** grey to dark brown, smooth and lenticellate to fissured and scaly; inner bark red-brown, fibrous with cream wedges outwards. **Sapwood** white. **Twigs** *puberulent to tomentose, rarely glabrous* when young, glabrescent and with numerous lenticels when older. **Stipules** often caducous, almost orbicular, subreniform or broadly spatulate, 0.8–1.5 × 0.8–1.8 cm, abaxial surface strigose towards the base, adaxial surface glabrous. **Leaves** with (0–)1–8 pairs of lateral leaflets, 5.5–15.5 cm long; petiole and rachis terete, *not winged*, glabrous to tomentose-velutinous; petioles 1–3 cm long; rachis segments between pairs of leaflets 1–2.5 cm long; *leaflets chartaceous to subcoriaceous, not bullate, margin flat or slightly recurved*, rounded or triangular crenate, with 8–14 notches on each side in the largest lateral leaflets, glabrous except for hirsute hairs on midrib below and sometimes also above towards base, sometimes almost shiny above, *drying greenish brown*; *lateral leaflets* almost sessile, *lanceolate to narrowly elliptic or narrowly ovate to ovate*, largest (2.2–)4.2–8.5(–12) × (0.8–)1.2–3.5(–4.5) cm (proximal leaflets usually smaller than distal ones), *base rounded to cuneate, unequal, apex narrowly acute to acuminate*; terminal leaflets narrowly elliptic to narrowly ovate, 2.5–10 × 1–3.3 cm, base attenuate, apex acuminate; midrib prominent below, sunken above; lateral and intercostal veins slightly prominent below, almost flat above; petiolules of 0.3–1.5 cm long. **Inflorescences** 1–3 of opposite pairs of lateral dyads or tetrads; peduncles 0.3–1.8 cm long, minutely puberulent to tomentose; individual racemes 7.5–15 cm long, axes minutely puberulent to tomentose. **Flowers** unisexual or bisexual; pedicels (1.1–)1.5–3 mm long, minutely hairy; calyx lobes triangular, 0.6–0.9 mm long, hirsute at base; petals oblong to obovate, 1.1–1.8 × 0.7–1.2 mm, apex rounded or rarely emarginate; disc lobes free and oblong, 0.2–0.5 mm long, or rarely forming an almost complete ring. **Male flowers:** filaments *c.* 2.9 mm long, pistillodes *c.* 0.5 mm long, densely pubescent, styles *c.* 0.1 mm, incurved. **Female flowers:** staminodes 0.6–1.2 mm long; ovary 0.6–1.2 mm long, densely pubescent, styles 1–1.3 mm long, straight. **Bisexual flowers:** filaments 3–3.5 mm long; ovary 0.6–0.8 mm long, pubescent, styles 1.5–2 mm long, straight. **Fruit** valves 2.5–4(–6) × 1.5–2(–3.1) mm at dehiscence; exocarp pubescent; calyx lobes usually persistent. **Seeds** 0.8–1.1 mm long, with a tuft of hairs at both ends, hairs to 2 mm long.

Vernacular names. Sabah—*sumu silan* (preferred name); *kayu-papan* (Murut). Sarawak—*tekar* (Kelabit); *tansang lang* (Iban); *uban* (Iban).

Distribution. Sumatra, Peninsular Malaysia, Singapore, Java, Borneo, Maluku, Lesser Sunda Islands, New Guinea and Solomon Islands. In Sabah, known from Kota Belud, Labuk Sugut, Lahad Datu, Penampang, Ranau, Sandakan, Tambunan, and Tuaran districts (e.g.,

Ahmad Zainudin AZ 4953, Ali AI 412, FRI 41324, SAN 37765, SAN 60638, SAN 62024, SAN 95210, SAN 140143, SFN 27845, SNP 15569, and Sugau JBS 64). In Sarawak, reported from Belaga, Kapit, Kuching, Lawas, Limbang, Marudi, and Miri districts (e.g., *Sarawak Museum Series 40, S 3777, S 10609, S 18535, S 20036, S 21116, S 26012, S 37053, S 51142, and S 52496*). Also occurs in Brunei (e.g., *BRUN 1044, BRUN 1873 and Coode MC 7566*) and Kalimantan (e.g., *Kostermans 12903*).

Ecology. In Malesia, *Weinmannia fraxinea* is the most widely distributed and morphologically the most variable species. The species also has a wide ecological amplitude, occurring in various habitats on different soil types. In Borneo, it occurs in mixed peat swamp (*Agathis* forest) at sea level, mixed dipterocarp, *kerangas*, lower and upper montane forests at (0–)500–1970 m altitude. On Mt. Kinabalu in Sabah, the species has been recorded from dwarf, open montane forest on ultramafic soils.

Uses. In Sarawak, the leaves are boiled in water and then mixed with clay to make a blackish dye (*Chai S 35503*) and the wood is used as firewood.

Notes. The leaflets of this species are variable in number, size, shape, texture and indumentum, but usually they are broader towards the unequal base and the apex is acuminate.

HERNANDIACEAE

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Blume, Bijdr. Fl. Ned. Ind. (1826) 550; Gamble, J. As. Soc. Beng. 75, 1 (1912) 203; Ridley, FMP 3 (1924) 138; Backer & Bakhuizen *f.*, FJ 1 (1964) 135; Hutchinson, Gen. Fl. Pl. 1 (1964) 143; Kubitzki, Bot. Jahrb. Syst. 89 (1969) 78; Ng, TFM 2 (1973) 244; Keng, OFMSP rev. ed. (1978) 37; Corner, WSTM 3rd. ed., 2 (1988) 363; Kubitzki in Kubitzki *et al.* (eds.), Fam. Gen. Vasc. Pl. 2 (1993) 334; Duyfjes, FM 1, 12 (1996) 737; Beaman *et al.*, PMK 4 (2001) 379.

Trees, shrubs, or woody climbers. **Leaves** alternate or spirally arranged, petiolate, without stipules, simple (lobed or unlobed) and palmately or pedately veined, or palmately compound with 3–5 pinnately veined leaflets, margin entire. **Inflorescences** axillary or terminal, much-branched, compound cymes or corymbose thyrses, with or without bracts. **Flowers** bisexual or unisexual (plants polygamous or monoecious, rarely dioecious); perianth sepaloid with 3–8 imbricate or valvate segments (tepals) in 1 or 2 whorls; stamens 3–7 in a single whorl opposite the tepals, or if the tepals in two whorls, inserted opposite the outer tepals, filaments with two basal glands, or with one dorsal gland, or without glands, anthers 2-locular, dehiscing through 2 lateral or apical valves; interstaminal staminodes present or absent; ovary inferior, 1-locular, with 1 pendulous ovule, style simple, in male flowers absent or reduced, stigma discoid and oblique or capitate. **Fruits** indehiscent, drupe-like and enclosed by inflated, fleshy, expanded cupule (*Hernandia*) or dry and nut-like with 2–4 lateral wings (*Illigera*). **Seed** 1, without endosperm; embryo straight; cotyledons large, fused and ruminate (*Hernandia*) or free and more or less planoconvex or slightly unequal (*Illigera*).

Distribution. Four genera (*Gyrocarpus* Jacq., *Hernandia* L., *Illigera* Blume and *Sparattanthelium* Mart.) with about 60 species; in tropical regions of Asia, Africa, C America and Mexico. Three species in 2 genera (*Hernandia* and *Illigera*) are recorded for Sabah and Sarawak.

Taxonomy and classification. In the past, genera currently included in the Hernandiaceae have been placed in different families (Combretaceae, Hernandiaceae and Lauraceae) but Kubitzki (*op. cit.* 1969) in publishing the monograph of the family comprehensively dealt with the perceived differences. Most authors (e.g., Hutchinson *op. cit.*, Keng *op. cit.*, Cronquist (1981), Int. Syst. Class. Fl. Pl.: 78, Kubitzki *et al. op. cit.*, Bremer *et al.* (2003), APG II, Bot. J. Linn. Soc. 141: 399) agree that Hernandiaceae is closely related to Lauraceae. The family can be divided into two subfamilies, viz. Hernandioideae and Gyrocarpoideae. The two genera occurring in Sabah and Sarawak belong to the subfam. Hernandioideae.

Key to genera

Trees with simple leaves. Fruits a drupe enclosed in a cupule.....**Hernandia**

Woody climbers with palmately compound leaves. Fruits with wings.....

Illigera Blume

(Latin, *illigare* = to entangle)

Bijdr. Fl. Ned. Ind. (1826) 1153; Clarke *in* Hooker *f.*, Fl. Brit. Ind. 2 (1879) 460 (under Combretaceae); King, J. As. Soc. Beng. 66, 1 (1897) 342 (under Combretaceae); Gamble, J. As. Soc. Beng. 75, 1 (1912) 203; Ridley, FMP 3 (1924) 139; Merrill, PEB (1929) 91; Backer & Bakhuizen *f.*, FJ 1 (1964) 136; Ng, TFM 2 (1973) 247; Kubitzki, Bot. Jahrb. Syst. 89 (1969) 157, *in* Kubitzki *et al.* (eds.), Fam. Gen. Vasc. Pl. 2 (1993) 337; Duyfjes, FM 1, 12 (1996) 751; Beaman *et al.*, PMK 4 (2001) 380.

About 20 species mainly in the Sino-Himalayan region; in the Flora region, two species, *I. celebica* Miq. and *I. megaptera* Merr., were recorded for Sabah only.

Woody climbers, climbing with the aid of twining petioles. Leaves palmately 3(–5)-foliolate, leaflets pinnately veined. Inflorescences terminal and axillary, many- or few-flowered. Flowers bisexual, 5-merous, tepals in two rows, valvate in bud, caducous; ovary ovoid, 4-angled, in fruit the angles develop into 2 or 4 wings, style filiform; stamens 5. Fruit a samara; the nut with 2 longer and 2 shorter lateral wings (or wings sometimes absent). In forests or forest edges, at altitudes to 1660 m.

HERNANDIA L.

(F. Hernandez, 16th century Spanish naturalist and explorer)

Sp. Pl. (1753) 981; Blume, Bijdr. Fl. Ned. Ind. (1826) 550; Hooker *f.*, Fl. Brit. Ind. 5 (1890) 188 (under Lauraceae); Gamble, J. As. Soc. Beng. 75, 1 (1912) 203; Ridley, FMP 3 (1924) 138; Masamune, EPB (1942) 318; Backer & Bakhuizen *f.*, FJ 1 (1964) 136; Kubitzki, Bot. Jahrb. Syst. 89 (1969) 122; Ng, TFM 2 (1973) 244; Corner, WSTM 3rd. ed., 2 (1988) 363; Kubitzki *in* Kubitzki *et al.* (eds.), Fam. Gen. Vasc. Pl. 2 (1993) 337; Duyfjes, FM 1, 12 (1996) 737; PROSEA 5, 3 (1998) 287. **Synonym:** *Biosolettia* C.Presl, Reliq. Haenk. 2 (1835) 141.

Monoecious trees or shrubs. **Leaves** spirally arranged, *simple, peltate or not, palmately 3–9-veined, veins arching towards apex*. **Inflorescence** usually at and towards the tips of branchlets; all parts finely pubescent, rarely glabrous; *peduncles distinct; ultimate (distal) partial inflorescences (cymules) comprising 2 lateral pedicelled male flowers and 1 central subsessile female (rarely bisexual) flower, subtended by an involucre of 4 bracts*. **Flowers:** bracteoles of male flowers more or less equal, *those of female flowers united into a cupule partly or wholly surrounding the ovary, accrescent at maturity*; outer tepals quincuncial or imbricate, inner ones valvate. **Male flowers** 3–5(–6)-merous; *pistillode absent or style rudimentary*; *stamens 3–5(–6), filaments free or partly connate, each with 2, free or connate basal glands*. **Female flowers** 4–6-merous; staminodes absent; ovary somewhat compressed laterally, style sigmoid or straight, at base often thickened and surrounded by 4–5(–10–12) free or connate glands, stigma dilated or irregularly lobed. **Fruits** *drupe-like*, ovoid to ellipsoid, often inconspicuously longitudinally ribbed, with or without an umbo (wart) at apex, *at maturity enclosed by the inflated, fleshy cupule*. **Seeds** with a hard, sometimes spongy testa; *cotyledons fused, ruminant*.

Distribution. Pantropical genus of 24 species; 3 in Malesia. Only 1 species in Sabah and Sarawak.

Hernandia nymphaeifolia (C.Presl) Kubitzki

Fig. 1.

(Latin, leaves like that of the water lily, *Nymphaea*)

Bot. Jahrb. Syst. 90 (1970) 272; Ng *op. cit.* 245; Corner *op. cit.* 363; Turner, Gard. Bull. Sing. 47 (1995) 266; Duyfjes *op. cit.* 747; PROSEA *op. cit.* 287. **Basionym:** *Biasolettia nymphaeaeifolia* C.Presl *op. cit.* 142. **Type:** *Haenke s.n.*, Guam (PR). **Synonyms:** *Hernandia peltata* Meisn. in A. DC., Prodr. 15 (1864) 263, Hooker *f. op. cit.* 188, Gamble *op. cit.* 204, Merrill, EB (1921) 280, Ridley *op. cit.* 138, Backer & Bakhuizen *f. op. cit.* 137, Kubitzki *op. cit.* (1969) 153; *Hernandia ovigera auct. non L.*: Masamune *op. cit.* 318.

Tree, 20–35 m tall, 50–100 cm diameter; bole short, low branching. Bark grey-brown, smooth to rough, lenticellate; inner bark thick, fibrous, soft, yellow to dirty brown. **Sapwood** white to yellow to pale orange. **Twigs** 0.5–1 cm diameter apically, smooth, with a broad pith. **Leaves** *palmately 5–9-veined*; petioles 10–20 cm long; blades chartaceous to thinly coriaceous, shiny above, dull below, glabrous on both surfaces, *peltate (rarely non-peltate or barely peltate), attached to the petiole at (0–)0.5–3 cm from margin*, broadly ovate, 10–33 × 6–29 cm, *base rounded to slightly cordate*, apex acute to slightly acuminate; midrib and veins flat to slightly raised above, raised below; *midrib with 2–4 pairs of lateral veins*. **Inflorescences** 3–5 crowded towards apex of twig, 10–30 cm long; *main axes 6–20 cm long*; involucre bracts elliptic to obovate 2–6 × 1–3.5 mm. **Flowers** greenish or white, fragrant. **Male flowers** 3-merous; pedicels 4–4.5 mm long; tepals c. 5 mm long; filaments c. 3 mm long, each basally with two subspathulate glands c. 1 mm long, the glands free or pair-wise fused between stamens, anthers yellow. **Female flowers** 4-merous, more or less sessile, 8–10 mm long; tepals 5–6 mm long; glands 4 (sometimes more), ellipsoid; *ovary enveloped up to halfway by the cupule*, style 3–4 mm long, papillose, stigma pink; cupule at anthesis c. 2 × 3 mm, *margin entire of slightly undulate*. **Cupule** (in fruit) loosely enclosing the drupe, inflated, bell-shaped, fleshy, waxy, white or reddish, *margin of the orifice entire and slightly revolute*. **Fruits** *as long as cupules or somewhat exserted*, ellipsoid, 2.5–3 × 1.5–2.3 cm, faintly longitudinally 8-ribbed, short-stalked or sessile, *apex with an umbo, 8–10 mm wide, 2–3 mm high*.

Vernacular names. Sarawak—*kementing laut* (Malay); Peninsular Malaysia—*buah keras laut* (Malay).

Distribution. E Africa, Madagascar, Sri Lanka, Andaman and Nicobar Islands, Thailand, Cambodia, Vietnam, Taiwan, Malesia (Sumatra, Peninsular Malaysia, Borneo, Java, Nusa Tenggara, Sulawesi, the Philippines, Maluku and New Guinea), Micronesia, Melanesia and Polynesia. In Sabah, known from Pulau Tiga, Kuala Penyu district (e.g., *SAN 84739*, *SAN 126793* and *SAN 126972*), Pulau Gaya, Kota Kinabalu district (e.g., *SAN 31355*, *SAN 56123* and *SAN 67178*), Pulau Banggi, Kudat district (e.g., *SAN 16418*), Pulau Timbun Mata and Pulau Sipadan, Semporna district (e.g., *FD FMS 48713* and *Wong WKM 2467*), and in Sarawak from Kuala Sg. Sematan and Pulau Talang Talang Besar, Lundu district (e.g., *Igon 452*, *S 20898* and *S 41812*), Buntal and Bako NP, Kuching district (e.g., *Hewitt 1031* and *S 43898*).

Ecology. Occurs exclusively in coastal areas, along sea-shores, in primary and secondary littoral forest (*Barringtonia asiatica* association), also behind the beach in swampy places; on sand, coral beach, or pebbles; at low altitude.

Uses. Timber is soft and light weight, not durable and of no major economic importance but

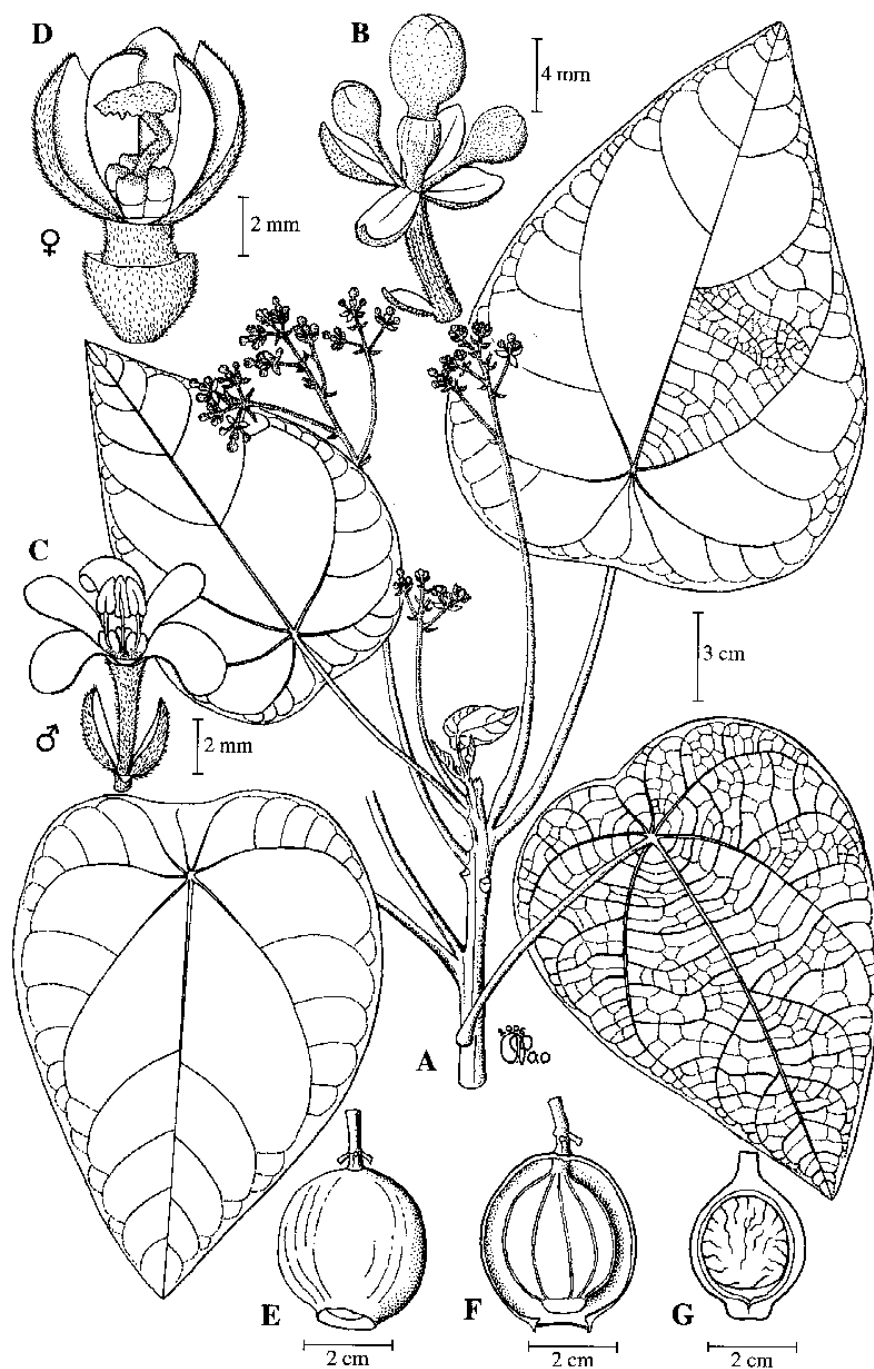


Fig. 1. *Hernandia nymphaeifolia*. A, flowering leafy twig; B, ultimate (distal) cymules with 1 female (centre) and 2 male (lateral) flowers; C, male flower; D, female flower; E, cupule and fruit; F, longitudinal section of cupule exposing the fruit; G, longitudinal section of fruit and seed showing the ruminant endosperm. (A–D from Wong WKM 2467, E–G from S 43898.)

is suitable for furniture, fish-net floats, wooden sandals and drawing boards. (*cf.* PROSEA *op. cit.*)

Notes. Most examined specimens have distinctly peltate leaves; however some specimens collected from islands off the coast of Sabah, e.g., *SAN 126972* from Pulau Tiga and *SAN 56123* from Pulau Gaya, have non-peltate and/or barely peltate leaves. Another specimen (*SAN 126793*, also from Pulau Tiga) has both peltate and non-peltate leaves on the same specimen sheet. These specimens, however, represent true *H. nymphaeifolia* and not *H. ovigera* L. as their fruit apices have the typical umbo found in *H. nymphaeifolia*. *Hernandia ovigera* typically have fruits without umbo.

MELIACEAE

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Miquel, Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 1; Hiern *in* Hooker *f.*, Fl. Brit. Ind. 1 (1875) 540; King, J. As. Soc. Beng. 64, 1 (1895) 16; Merrill, EB (1921) 318; Ridley, FMP 1 (1922) 382; Harms *in* Engler & Prantl, Nat. Pflanzenfam. ed. 2, 19b, 1 (1940) 1; Masamune, EPB (1942) 370; Backer & Bakhuizen *f.*, FJ 2 (1965) 116; Pennington & Styles, Blumea 22 (1975) 419; Anderson, CLTS (1980) 246; Mabberley & Pannell, TFM 4 (1989) 199; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 219; Kessler & Sidiyasa, TBSA-EK (1994) 166; Mabberley *et al.*, FM 1, 12 (1995) 1; Turner, Gard. Bull. Sing. 47 (1995) 336; Coode *et al.* (eds.), CLBD (1996) 200; Argent *et al.* (eds.), MNDT-CK (1997) 406; Beaman & Anderson, PMK 5 (2004) 118.

Trees, treelets, often pachycaul* or, more rarely, shrubs or suckering shrublets, monopodial or sympodial, rarely with *Terminalia*-branching (*Vavaea*), dioecious (though sometimes, at least, 'male' trees occasionally producing bisexual flowers), polygamous, monoecious or with all flowers bisexual. **Indumentum** of simple, bifid or stellate hairs or stellate or peltate scales or sometimes mixtures of these. **Buds scales** absent or present. **Leaves** exstipulate (occasionally pseudostipules present), spirally arranged, rarely decussate, pinnate (sometimes with a terminal 'bud', *i.e.* pseudogemmula), trifoliate, with a single blade (simple or unifoliate) or rarely bipinnate (*Melia*; introduced); rachis very rarely winged; leaflets usually entire, rarely lobed or serrate, sometimes with minute black glandular dots. **Inflorescences** thyrsoïd, racemose, paniculate or spicate, sometimes reduced to fascicles or solitary flowers, axillary, supra-axillary, on branches or bole to ground level. **Flowers** bisexual and/or more usually, unisexual with well developed rudiments of opposite sex present, radially symmetrical; calyx usually more or less lobed, sometimes with discrete sepals, sometimes truncate; petals 3–(–14) in 1 whorl or rarely in a spiral (some

*As used in FM and Flora North America, etc. = sparsely or not branched, of massive primary construction with wide pith and terminal heads of leaves arising from massive buds; the opposite being leptocaul.

Chisocheton) to give up to 2 apparent whorls, when fresh green, white, cream, pink to claret and violet or yellow (*Aglaia*); stamens usually partially or completely united by a tube with or without lobes, anthers 3–10(–30) in 1 or, rarely, 2 or more whorls, sometimes locellate (= divided into secondary, smaller compartments), inserted at tips of filaments or at the margin of the tube or within its throat; nectary disc around ovary cushion-like, tubular or absent; ovary superior (or in *Sandoricum* slightly sunk in receptacle), (1 or)2–6(–20)-locular, each locule with 1–many ovules, stigma or stylehead** discoid to capitate. **Fruit** a capsule, berry or drupe. **Seeds** with fleshy aril or sarcotesta or a combination of these or winged and then attached to a woody columella, or with corky outer layers, or very rarely without any of them; endosperm usually absent; cotyledons collateral, superposed or, rarely, oblique, emergent or not at germination, when scale leaves (eophylls) are sometimes produced before first foliage leaves, which may be opposite or spirally arranged, simple or pinnate with later ones simple to bipinnate.

Distribution. Throughout the tropics and subtropics, with poor representation in temperate zones, the family comprises two subfamilies (Meliodeae and Swietenioideae [older name Cedreloideae]) of 49 or 50 genera with about 620 species. It is best represented in the Malesian region for, although Africa is almost as diversified in terms of the number of genera, Sabah and Sarawak alone have far more species (130 in 15 genera) than the whole of Africa (84 species) and exactly matches the specific richness of the whole neotropical region, where only eight genera are found. It is notable that by comparison with the thousands upon thousands of specimens in herbaria of the easily collected smaller trees, notably species of *Aglaia*, *Chisocheton* and smaller species of *Dysoxylum*, there is only a handful of specimens of the tall timber species of *Toona* and *Dysoxylum* (e.g., *D. acutangulum*, *D. carolinae*, *D. crassum* and *D. flavescens*), for example, so that their distributions noted below may not be as accurate records as are those of the lesser species.

Ecology. Meliaceae are very common trees of the canopy and understorey of lowland primary forest throughout Malesia, making up to 17% of all trees over 10 cm bole diameter (Whitten *et al.*, Sumatra (1984) 262) in the forests of Sumatra for example, and being absent from only the driest zones. They are represented by species of *Xylocarpus* on rocky shores and in mangrove swamps, into the upper reaches of which penetrates *Aglaia rubiginosa*. The family is represented in freshwater swamp forest by *Sandoricum borneense* and *Chisocheton amabilis* and includes some species restricted to limestone habitat, like *C. ruber* and *Walsura grandifolia* of Sarawak. Along rivers in west Malesia, are a number of rheophytic species including, in Borneo, *Sandoricum borneense*. A few species are tolerant of more open conditions and will colonize large gaps in forest or are frequently encountered in secondary forest e.g., *Aglaia argentea*, *Toona* spp. and *Chukrasia tabularis*, which even colonizes bare ground along road cuttings and is weedy where introduced, as in Australia.

Uses. The timbers of certain Meliaceae are some of the most sought after in the world, such that natural stands have been much depleted and serious conservation measures have been proposed for wild mahoganies (*Swietenia* spp.) in tropical America. Most ‘mahogany’ (if Meliaceous at all) seen today is derived from *S. macrophylla* introduced to the Old World, probably from Honduras, in 1876 and described from material cultivated in India. It is grown in Sabah and Sarawak. The other important timbers are also generally Swietenioideae, notably *toon*, *Toona ciliata* from India to Australia (‘red cedar’), where most of it has been long cut out, having been the most desirable timber in that continent.

**As distinct from the stigmatic organs themselves (*cf. Sandoricum* for example).

Others include the neotropical *Cedrela odorata* tried in Borneo and species of the African genera *Entandrophragma* (e.g., *E. utile* Sprague), *Khaya* (African mahogany; *K. senegalensis* (Desr.) A.Juss. are common avenue trees in Kuching while *K. ivorensis* A.Chev. has been tried in plantation in Sabah) and *Lovoa* (Nigerian golden walnut). Besides the *Toona* spp. and *Chukrasia tabularis*, the chickrassy wood of commerce, indigenous species are not of world significance in the timber market, despite their large boles, though locally, some species of *Aglaia*, *Dysoxylum* and *Walsura*, and *Azadirachta excelsa*, have been used for construction and furniture, while *Xylocarpus* wood is hard and used for boat-building.

The major problem besetting plantation forestry of Meliaceae is the attacks by moths of the genus *Hypsipyla* (Lepidoptera, Pyralidae), the larvae of which burrow into young plants and seedlings, causing their collapse and death, though Melioideae seem to be rarely attacked — a good argument for their promotion as plantation trees. The shoot-borer is perhaps one of the most economically important insect pests in tropical forestry. There have been many attempts at biological control of the moths, for externally applied insecticides have little effect and systemic ones are expensive. Mixed and enrichment planting with non-susceptible species has been shown to reduce damage and there are possible advances to be made in breeding resistance to attack (see Newton *et al.*, For. Ecol. Manag. 57 (1993) 301 for further details).

The locally very important fruit trees, *Lansium domesticum* (*langsats* and *duku langsats*) and *Sandoricum koetjape* (*sentul*) exist in a number of forms, wild, cultivated and naturalized, though they are not grown on a commercial plantation scale, those reaching markets being largely those selected from kampung trees. A good *langsats* and/or *duku langsats* may be worth more as a proposition than a good durian tree. Seeds of a number of species of *Aphanamixis* and *Chisocheton* yield an oil which has been used as an illuminant, while those of *Lansium domesticum* are used in arrow poisons, as is the bark.

The bitterness (due to the triterpenoids) of the barks of Meliaceae has long been known and they have been used in medicine, some being those eagerly sought by Europeans in the eighteenth century, notably species of *Aphanamixis*, *Chukrasia*, *Heynea*, *Lansium*, *Sandoricum*, *Toona*, and *Xylocarpus*. The bark and indeed, the leaves of the exotic *Azadirachta indica*, the *neem*, are powerful insecticides and this tree (q.v.) has a host of uses including planting in the reclamation of derelict land: it is perhaps one of the most all-round useful trees of Asia. The triterpenoids, which are responsible for the insecticidal properties, have aroused considerable commercial interest and have been examined in a number of genera for their use as biological pesticides. The biological activities of these compounds including insect antifeedant and growth-regulating properties, medicinal effects in humans and other animals, antifungal, bacteriocidal and antiviral activity, are reviewed by Champagne *et al.* (Phytochemistry 31 (1992) 377). Similar bioactivity is attributed to cyclo[b]benzofurans in *Aglaia* (see under account of *Aglaia*).

A number of exotics, notably the Indian cultivars of *Melia azedarach* are planted (e.g., in Sabah) for their elegant foliage and fruits.

Key to subfamilies

Bud scales absent. Fruits capsules, berries or drupes. Seeds neither corky nor winged.....
subfam. **Melioideae** (genera occurring in Sabah and Sarawak: *Aglaia*, *Aphanamixis*,

Azadirachta, Chisocheton, Dysoxylum, Heynea, Lansium, Melia, Pseudoclausena, Reinwardtiodendron, Sandoricum, Vavaea and Walsura).

Bud scales present. Fruits woody septifragal capsules with central columella. Seeds winged or

corky.....
subfam. **Swietenioideae** (genera occurring in Sabah and Sarawak: *Cedrela, Chukrasia, Swietenia, Toona* and *Xylocarpus*).

Key to genera

1. Leaves bipinnate (planted).....
Melia L.
 (Greek name for the European ash trees, *Fraxinus*; alluding to the leaf shape)
 Sp. Pl. 1 (1753) 384; King, J. As. Soc. Beng. 64, 1 (1895) 17; Ridley, FMP 1 (1922) 384; Harms in Engler & Prantl, Nat. Pflanzenfam. ed. 2, 19b, 1 (1940) 99; Pennington & Styles, Blumea 22 (1975) 463; Mabberley, Gard. Bull. Sing. 37 (1984) 463; Corner, WSTM 3rd. ed., 2 (1988) 502; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 219; Mabberley *et al.*, FM 1, 12 (1995) 329.
 Trees, occasionally flowering precociously as shrublets. Indumentum of simple and stellate-tufted hairs. *Bud scales absent. Leaves bipinnate.* Inflorescences thyrsoid, axillary. Flowers bisexual and male on same tree; calyx 5(or 6)-lobed to near base, lobes somewhat imbricate; petals 5 (or 6), free, imbricate; staminal tube narrowly cylindrical, slightly expanded at mouth, 10(–12)-ribbed, with 10 or 12 truncate, bifid or 4-fid filiform lobes, anthers 10 (or 12), inserted at margin or just within tube, alternating with or opposite lobes; disc small, surrounding the base of ovary; ovary 4–8-locular, each locule with 2 superposed ovules, stylehead capitate to coroniform (= shaped like a crown) with 4–8 short, erect or incurved stigmatic lobes. Fruit a drupe, 3–8-locular, each locule with 1 or 2 seeds; endocarp thick, bony, deeply dimpled at base and apex. Seeds oblong, laterally compressed; testa leathery, sometimes slightly swollen and fleshy around hilum; embryo embedded in oily endosperm; cotyledons flat, collateral; radicle superior, short, projecting from the cotyledons. Germination phanerocotylar; eophylls opposite, pinnatisect or trifoliate.
 Two or possibly 3 species growing wild in tropical Africa and from India, Nepal, Sri Lanka and tropical China south and east through Sumatra, Java, the Philippines, Nusa Tenggara (Lesser Sunda Islands), New Guinea to tropical Australia and the Solomon Islands. One species, *M. azedarach* L., is planted and naturalised throughout the tropics, including Sabah and Sarawak.
 A glycopeptide, meliacin, isolated from the leaves and roots is responsible for inhibition of in-vitro replication of various DNA and RNA viruses. The seeds yield an oil and the trunk a gum but these have been little utilised, though the first is suitable for soap and hair oil.
 Leaves pinnate to simple (native and planted).....2
2. Leaves all simple (or unifoliate).....3
 Leaves pinnate to trifoliate.....4
3. Hairs simple. Trees with *Terminalia*-branching.....**13. Vavaea**
 Indumentum of at least some stellate hairs and/or stellate or peltate scales. Tree branching otherwise.....**1. Aglaia** (in part)

4. Leaves all trifoliolate.....5
Leaves pinnate (imparipinnate or paripinnate).....6
5. Hairs simple.....**11. Sandoricum**
Indumentum of stellate hairs and/or stellate or peltate scales.....**1. Aglaia** (in part)
6. Leaves with pseudogemmula (apical buds).....**4. Chisocheton** (in part)
Leaves without pseudogemmula.....7
7. Leaves/leaflets with scales and/or stellate hairs (sometimes very sparse).....**1. Aglaia** (in part)
Leaves/leaflets with simple hairs or glabrous.....8
8. Bud scales present.....9
Bud scales absent.....14
9. Leaves with (1 or)2–4(or 5) leaflets on each side of rachis. Mangrove trees with spherical fruits.....**15. Xylocarpus**
Leaves with more leaflets. Rainforest trees.....10
10. Leaves with 3–8 leaflets on each side of rachis. Fruits to 15 cm long (planted).....
Swietenia Jacq.
(Gerard van Swieten, 1700–1772; a Dutch physician)
Enum. Syst. Pl. Carib. 4 (1760) 20; Harms in Engler & Prantl, Nat. Pflanzenfam. ed. 2, 19b, 1 (1940) 70; Backer & Bakhuizen *f.*, FJ 2 (1965) 117; Pennington & Styles, Blumea 22 (1975) 521; Corner, WSTM 3rd. ed. 2 (1988) 507; PROSEA 5, 1 (1993) 442.
Deciduous trees. *Bud scales present. Leaves paripinnate*, very rarely imparipinnate, *without pseudogemmula, with (2 or)3–6(–8) leaflets* on each side of rachis; *leaflets* entire, *glabrous*. Inflorescences thyrsoid, axillary, little-branched. Flowers unisexual, 4- or 5-merous; calyx 5-lobed to about the middle, the lobes obtuse, imbricate; petals (4 or) 5, much longer than the calyx in bud, contorted, reflexed in open flowers; staminal tube cup-shaped or urceolate (= urn-shaped), 8–10-lobed, anthers 8–10, opposite the lobes; disc in males patelliform (= kneecap-shaped), united with the base of staminal tube, forming a ring around pistillode, in females reduced to a swelling at the base of ovary; ovary 5-locular, each locule with 12–16 ovules, stylehead discoid. Fruit an erect, strongly woody, oblong, ovoid or obovoid, septifragal capsule, *to 15 cm long*, opening by 5 valves from the base or base and apex simultaneously, the valves separating into an outer thickly woody and inner thinner layer. Seeds 9–16 per locule, attached by the wing-end to the distal part of columella; endosperm present as a thin layer; embryo with thin cotyledons; radicle slightly exerted. Germination cryptocotylar; eophylls opposite, simple, entire.
Two (or 3) species in tropical America (from Mexico to Brazil) and the Caribbean. One species, *S. macrophylla* King, was introduced to Java in 1872 and to Singapore in 1876 and since grown in Peninsular Malaysia, Borneo (Sabah and Sarawak) and the Philippines for plantation and/or roadside trees.
Leaves with more leaflets (native and planted).....11
11. Leaflets strongly asymmetrical. Petals 12–16 mm long.....**5. Chukrasia**
Leaflets not so. Petals much smaller.....12

12. Staminal tube urceolate or cupular, anthers 8 or 10. Fruits (sub)globose. Seeds winged all round (planted).....

Khaya A.Juss.

Bull. Sci. Nat. Géol. 23 (1830) 238; Harms *in* Engler & Prantl, Nat. Pflanzenfam. ed. 2, 19b, 1 (1940) 49; Pennington & Styles, Blumea 22 (1975) 515; PROSEA 5, 3 (1998) 310.

Deciduous, monoecious trees. *Bud scales present. Leaves paripinnate, without pseudogemmula; leaflets entire, glabrous.* Inflorescences thyrsoid, axillary, much-branched. Flowers unisexual, 4- or 5-merous; calyx 4- or 5-lobed almost to base, the lobes subcircular, imbricate; petals 4 or 5, free, *less than 12 mm long*, much longer than the calyx in bud, contorted, erect in open flowers, somewhat hooded; *staminal tube urn-shaped or cup-shaped, bearing 8–10 included anthers* or antherodes (= sterile anthers) toward the apex; disc in males cushion-shaped, united with the base of pistillode, but free from staminal tube, in females more or less reduced to an indistinct swelling at the base of ovary; ovary 4- or 5-locular, each locule with 12–16(–18) ovules, stylehead thick discoid with crenulate margin. Fruit an erect, (sub)globose woody, septifragal capsule, opening by 4 or 5 (or 6) valves from the apex, the valves remaining joined at the base. Seeds 8–18 per locule, broadly transversely ellipsoid to suborbicular, *narrowly winged all around margin*; residual endosperm present; embryo with flat collateral cotyledons; radicle lateral, slightly exserted. Germination cryptocotylar; eophylls opposite, simple, entire, apex often long-acuminate.

About 6 or 7 species in tropical Africa, Madagascar and the Comores. Two species, *Khaya ivorensis* A.Chev. and *K. senegalensis* (Desr.) A.Juss., have been introduced to Sabah and Sarawak for plantation and/or roadside trees.

Stamens 5, free. Fruits ellipsoid, obovoid or club-shaped. Seeds winged at end(s) only (native and planted).....13

13. Androgynophore cushion-shaped not exceeding ovary. Seeds winged at both ends or if at one end then attached at base of columella (native and planted).....**12. Toona**
Androgynophore columnar, longer than ovary. Seeds winged at one end and attached towards apex of columella (planted).....

Cedrela P.Browne

(Latin, *cedrus*, the cedar tree; referring to the strong-smelling wood)

Civ. Nat. Hist. Jamaica (1756) 158; King, J. As. Soc. Beng. 64, 1 (1895) 89; Ridley, FMP 1 (1922) 415; Harms *in* Engler & Prantl, Nat. Pflanzenfam. ed. 2, 19b, 1 (1940) 40; Earle Smith, Fieldiana, Botany 29 (1960) 295; Pennington & Styles, Blumea 22 (1975) 512; Corner, WSTM 3rd. ed. 2 (1988) 498; PROSEA 5, 2 (1995) 122.

Deciduous trees. *Bud scales present. Leaves paripinnate, very rarely imparipinnate, without pseudogemmula, usually with (5 or)6–12(–15) leaflets on each side of rachis; leaflets entire, glabrous or simple-hairy.* Inflorescences thyrsoid, axillary, much-branched. Flowers 5-merous, unisexual; calyx lobed more or less to the base, shallowly dentate, or cup-shaped and split down one side; *petals 5, free, less than 12 mm long*, longer than the calyx in bud, aestivation imbricate; *stamens 5, free*, adnate to the *columnar androgynophore* below; ovary 5-locular, each locule with 6–12 ovules, style short, stylehead discoid with glandular stigmatic papillae. *Fruit* a thinly or thickly woody, *obovoid or club-shaped*, septifragal capsule, opening from the apex by 5 valves; columella woody, sharply 3-angled, extending to the apex of the capsule. *Seeds with a terminal wing* attached by the seed-end to the distal part of the columella and winged towards the base of the capsule; residual endosperm present; embryo with collateral, flat and

leaf-like cotyledons; radicle laterally exserted. Germination phanerocotylar; eophylls opposite, trifoliate, the leaflets sinuate, entire.

About 5–8 species all native to tropical America, from Mexico to Argentina and in the Caribbean. One species, *Cedrela odorata* L., a valuable source of cedar timber, is planted throughout the tropics, including Malaysia (Peninsular Malaysia and Sabah), Indonesia, the Philippines and New Guinea.

14. Leaves paripinnate (see also note under *Chisocheton patens*).....15
 Leaves imparipinnate (sometimes terminal leaflet represented by a scar).....18
15. Stigma with conspicuous lobes. Fruit a drupe (native & planted)..... **3. Azadirachta** (in part)
 Stigma unlobed. Fruit a capsule or berry.....16
16. Disc present. Fruit a capsule..... **6. Dysoxylum** (in part)
 Disc absent. Fruit a berry.....17
17. Anthers in 1 whorl of 10. Fruits on branches and trunk..... **8. Lansium**
 Anthers in 2 whorls of 5. Fruits on axillary infructescences.... **10. Reinwardtiodendron**
18. Leaf rachis swollen at insertion of leaflets..... **14. Walsura**
 Leaf rachis not swollen thus.....19
19. Petals 3; disc absent..... **2. Aphanamixis**
 Petals 4 or more; disc present or absent.....20
20. Staminal tube deeply lobed..... **7. Heynea**
 Staminal tube not deeply lobed.....21
21. Disc absent. Fruit a berry..... **9. Pseudoclausena**
 Disc present. Fruit a capsule or drupe.....22
22. Stigma with conspicuous lobes. Fruit a 1- or 2-seeded drupe (native & planted)..... **3. Azadirachta** (in part)
 Stigma without such lobes. Fruit a capsule.....23
23. Inflorescences bell-rope-shaped. Disc 1 mm tall or less..... **4. Chisocheton** (in part)
 Inflorescences not so. Disc bigger..... **6. Dysoxylum** (in part)

Spot characters for genera

Unbranched or sparsely branched pachycaul treelets: *Aglaia*, *Aphanamixis*, *Chisocheton*, *Dysoxylum*

Rheophytes: *Aglaia* (*A. lancifolia* and *A. rivularis*), *Sandoricum* (*S. borneense*)

Halophytes: *Xylocarpus*

Bark with white latex: *Aglaia*, *Chisocheton*

Slash strongly garlic- or *Scorodocarpus*-scented: *Dysoxylum* (*D. alliaceum*, *D. magnificum*, *D. mollissimum*, *D. rigidum* and the seeds of *Azadirachta excelsa*)

Indumentum of or with stellate hairs: *Aglaia*, *Chisocheton* (*C. koordersii*), *Melia* (*M. azedarach*)
 Indumentum of stellate or peltate scales: *Aglaia*
 Leaves opposite: *Dysoxylum*
 Leaves simple or unifoliate: *Aglaia*, *Vavaea*
 Leaves trifoliate: *Aglaia*, *Reinwardtiodendron*, *Sandoricum*
 Leaves imparipinnate: *Aglaia*, *Aphanamixis*, *Azadirachta*, *Chisocheton*, *Dysoxylum*, *Heynea*, *Pseudoclausena*, *Walsura*
 Leaves paripinnate (sometimes a lateral leaflet pseudoterminal): *Azadirachta*, *Chisocheton*, *Cedrela*, *Chukrasia*, *Dysoxylum*, *Khaya*, *Reinwardtiodendron*, *Swietenia*, *Toona*, *Xylocarpus*
 Leaves bipinnate: *Melia* (*M. azedarach*)
 Leaves with terminal bud (= pseudogemma): *Chisocheton*
 Inflorescences on bole: *Chisocheton*, *Dysoxylum*, *Lansium*
 Inflorescences on branches: *Aglaia*, *Chisocheton*, *Dysoxylum*, *Lansium*
 Inflorescences like bell-ropes: *Aphanamixis*, *Chisocheton*
 Flowers yellow: *Aglaia*
 Calyx deeply lobed with almost free orbicular sepal lobes: *Aphanamixis*, *Lansium*, *Reinwardtiodendron*
 Calyx valvate: *Xylocarpus*
 Petals in a spiral, sometimes appearing as 2 whorls: *Chisocheton*
 Corolla valvate: *Chisocheton*, *Dysoxylum*, *Walsura*
 Petals 3: *Aglaia*, *Aphanamixis*, *Vavaea*
 Filaments free: *Cedrela*, *Toona*
 Staminal tube globose: *Aglaia*, *Aphanamixis*, *Lansium*, *Reinwardtiodendron*
 Anthers in 2 or more whorls: *Aglaia* (rare), *Reinwardtiodendron*, *Sandoricum*, *Walsura*
 Anthers locellate: *Chisocheton*
 Disc absent: *Aglaia*, *Aphanamixis*, *Lansium*, *Pseudoclausena*, *Reinwardtiodendron*, *Vavaea*
 Disc tubular: *Dysoxylum*, *Sandoricum*
 Fruit a loculicidal capsule: *Aglaia*, *Aphanamixis*, *Chisocheton*, *Dysoxylum*, *Heynea*
 Fruit a septifragal capsule: *Walsura* (*W. dehiscens*)
 Fruit a berry: *Aglaia* (?), *Lansium*, *Pseudoclausena*, *Reinwardtiodendron*, *Vavaea*, *Walsura*
 Fruit a drupe: *Azadirachta*, *Sandoricum*
 Seeds winged: *Cedrela*, *Chukrasia*, *Khaya*, *Swietenia*, *Toona*
 Seeds corky: *Xylocarpus*

1. AGLAIA Lour., *nom. cons.*

(Greek, *Aglaia* = one of the Graces who presided over the original Olympic Games; beauty, lustre)

bekak (Malay), *langsar-langsar* (Malay), *lantupak* (Dusun), *segera* (Iban)

Caroline M. Pannell

Fl. Cochinch. (1790) 173; Miquel, Ann. Mus. Bot. Lugd. Bat. 4 (1868) 38; Hiern in Hooker f., Fl. Brit. Ind. 1 (1875) 554; King, J. As. Soc. Beng. 64, 1 (1895) 58; Harms in Engler & Prantl, Nat.

Pflanzenfam. 3, 4 (1896) 298; Merrill, EB (1921) 321, PEB (1929) 124; Ridley, FMP 1 (1922) 401; Masamune, EPB (1942) 370; Backer & Bakhuizen *f.*, FJ 2 (1965) 126; Pennington & Styles, Blumea 22 (1975) 481; Anderson, CLTS (1980) 246; Corner, WSTM 3rd ed. 2 (1988) 494; Pannell *in* Mabberley & Pannell, TFM 4 (1989) 207, Kew Bull. Add. Ser. 16 (1992) 379, *p.p.*, *in* Mabberley *et al.*, FM 1, 12 (1995) 194; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 219; Kessler & Sidiyasa, TBSEA-EK (1994) 167; PROSEA 5, 2 (1995) 38; Coode *et al.* (eds.), CLBD (1996) 200; Argent *et al.* (eds.), MNDDT-CK 2 (1997) 407; Beaman & Anderson, PMK 5 (2004) 118. **Synonyms:** *Amoora* Roxb., Pl. Corom. 3 (1820) 54, Miquel *op. cit.* (1868) 34, King *op. cit.* 51, Merrill *op. cit.* (1921) 321, Ridley *op. cit.* (1922) 398, Masamune *op. cit.* 373, Backer & Bakhuizen *f. op. cit.* 125, Anderson *op. cit.* (1980) 250; *Milnea* Roxb., Fl. Ind. 2 (1824) 430; *Nemodra* A.Juss., Bull. Sci. Nat. Géol. 23 (1830) 239; *Beddomea* Hook. *f.* *in* Bentham & Hooker *f.*, Gen. Pl. 1 (1862) 336; *Hearnia* F.Muell., Fragm. Phyt. Austr. 5 (1865) 55; *Agelaiopsis* Miquel *op. cit.* (1868) 58.

Small to large trees, *branched or rarely unbranched*, rarely much-branched shrubs, dioecious; *bark with white latex*. **Indumentum** of various types of hairs and/or scales. **Bud scales absent**. **Leaves** spirally arranged, either widely spaced on the apical shoots or close together with the petiole bases overlapping, *imparipinnate (very rarely paripinnate) or simple (unifoliolate)*, *without pseudogemma*; petiole usually terete, sometimes flat or deeply channelled on the adaxial side; leaflets usually asymmetrical, *glabrous or sparsely to densely covered with hairs and/or scales*, lateral ones alternate, subopposite or opposite, 2–17 on each side of rachis. **Inflorescences** *paniculate or spicate*, axillary, supra-axillary, or occasionally ramiflorous or cauliflorous, often several on an apical shoots; *males* much-branched, bearing up to 10,000 flowers; females less-branched and bearing fewer flowers. **Flowers** usually with fragrance of citronella; *males* terminal on short branchlets of rachis to 2.5 mm long, solitary or in sessile clusters; *females* solitary along rachis, sessile or nearly so, often larger than males; *calyx* cup-shaped, often thickened at the base, shallowly to deeply 3–5 (or rarely 6)-lobed, aestivation open or imbricate, the lobes unequal and sometimes patent at anthesis; *corolla* aestivation quincuncial or imbricate, petals 3–5 (or rarely 6), free or united at base, free from the staminal tube or partially united to it, unequal, concave and usually thickened in the centre, often hooded at the apex when in bud; *staminal tube* more or less truncate at base, apex incurved, without appendages, aperture small to large with entire, wavy or shallowly lobed margin, *anthers* (3–)5–9, in a single whorl, dehiscing by two longitudinal slits, inserted on the inner surface of the staminal tube either just below the margin or rarely on the margin; *antherodes* (= sterile anthers) in female flowers similar but not dehiscing and without pollen; *disc absent*; *ovary* 1–3 (rarely 4)-locular, each locule with 1 or 2 collateral or superposed ovules, placentation axial; *style* a very short constriction between the ovary and stylehead or absent, *stylehead* small, capitate, conical or clavate, *stigma* entire or with 2, 3 or rarely 4 small lobes. **Fruit** a 1–2 (rarely 3–6)-seeded berry (?) or a 2–4-valved, loculicidal capsule containing 2–4 seeds. **Seeds** usually with an aril or sarcotesta nearly or completely covering the seed; *endosperm absent*; *embryo* with thick planoconvex, superposed or rarely oblique cotyledons; *radicle* included. **Germination** subcryptocotylar; eophylls usually opposite, sometimes spirally arranged, simple or trifoliolate, margin entire.

Distribution. At least 115 species, occurring in tropical and subtropical India, Bangladesh, Sri Lanka, Bhutan, China, Andaman Islands, Great Cocos Islands, Myanmar, Laos, Vietnam, Thailand, Cambodia, Taiwan, Sumatra, Peninsular Malaysia, Singapore, Java, Nusa Tenggara (Lesser Sunda Islands), Borneo, the Philippines, Sulawesi (Celebes), Maluku (Moluccas), New Guinea, Australia, Guam, Ponape, Palau, Solomon Islands, Fiji, Samoa and New Caledonia. Sixty species occur in Sabah and Sarawak.

Ecology. Most species occur in lowland and hill forests, at altitudes to 1800 m. The seeds are dispersed by vertebrates. Birds swallow the arillate seeds from dehiscent fruits. Primates break open and take the seeds from indehiscent fruits. The bird-dispersed fruits have an opaque, usually red aril which contrasts with the white inner pericarp and pink or red outer surface of the pericarp. The aril is rich in lipids and can be peeled off the testa; it may therefore be removed in the bird's gizzard and the seed either regurgitated or passed rapidly through the gut. The primate-dispersed fruits have a gelatinous, sweet, often translucent aril which adheres so firmly to the testa that the primate tends to swallow the seed as well as the surrounding flesh; the seed is defaecated cleaned of its flesh. The indehiscent fruits of some species have a longitudinal line or lines of weakness in the pericarp along which the fruit breaks open if pressure is applied. (*cf.* Pannell & Koziol, Phil. Trans. Roy. Soc. London B 316 (1987) 303).

Phytochemistry. The genus *Aglaia* is the source of a unique group of natural products featuring a cyclopenta[b]tetrahydrobenzofuran skeleton. The first of these to be described was rocaglamide (King, M. *et al.* in J. Chem. Soc., Chem. Commun. 20 (1982) 1150–1). Since then, more than 50 naturally occurring derivatives of these compounds have been isolated from species in the genus. Most of these compounds have potent insecticidal properties, antifungal, antiviral, antibacterial or antihelmintic bioactivity. Several of them exhibit pronounced cytotoxic activity against a range of human cancers (see the review by Proksch *et al.*, Current Organic Chemistry 5 (2001) 923–938 and the website of Professor Harald Greger and Dr. Brigitte Brem at <http://www.phytochemie.botanik.univie.ac.at/herbarium/aglaia.htm>).

Taxonomy. Three sections, viz. sect. **Aglaia**, sect. **Amoora** and sect. **Neoaglaia** are recognised, which can be distinguished as follows:

Sect. **Aglaia**: Calyx with 5 (or rarely 6) obtuse or acute lobes; *petals* 5 (or rarely 6), aestivation quincuncial or imbricate (when petals 6); *anthers* (3–)5(–10). *Fruits* indehiscent, sometimes with one or more longitudinal ridges along which the pericarp splits open under pressure. *Seeds* with translucent, yellow, orange or white aril, flesh gelatinous. Species occurring in Sabah and Sarawak included in this section are: 1. *A. angustifolia*, 2. *A. argentea*, 4. *A. bullata*, 5. *A. coriacea*, 6. *A. crassinervia*, 8. *A. cumingiana*, 9. *A. densisquama*, 10. *A. edulis*, 11. *A. elaeagnoidea*, 12. *A. elliptica*, 14. *A. exstipulata*, 15. *A. forbesii*, 16. *A. foveolata*, 17. *A. glabrata*, 18. *A. glabriflora*, 19. *A. grandis*, 20. *A. hiernii*, 21. *A. korthalsii*, 22. *A. lancifolia*, 23. *A. lancilimba*, 25. *A. laxiflora*, 26. *A. leptantha*, 27. *A. leucophylla*, 28. *A. luzoniensis*, 31. *A. meliosmoides*, 32. *A. monozyga*, 34. *A. neotenica*, 35. *A. odoratissima*, 36. *A. oligophylla*, 37. *A. pachyphylla*, 38. *A. palembanica*, 39. *A. ramotricha*, 40. *A. rivularis*, 42. *A. rufibarbis*, 43. *A. rufinervis*, 45. *A. scortechinii*, 46. *A. sessilifolia*, 47. *A. sexipetala*, 48. *A. silvestris*, 49. *A. simplicifolia*, 50. *A. soepadmoi*, 51. *A. speciosa*, 53. *A. squamulosa*, 54. *A. stellatopilosa*, 55. *A. sterculioides*, 56. *A. subsessilis*, 57. *A. tenuicaulis*, 59. *A. tomentosa* and 60. *A. variisquama*.

Sect. **Amoora**: Calyx with 3 broadly obtuse lobes; *petals* 3, aestivation imbricate; *anthers* 6–21. *Fruits* more than 6 cm long, dehiscent. *Seeds* with opaque aril, which when fresh has red, white or yellow outer skin. This section is, in Sabah and Sarawak, represented by: 7. *A. cucullata*, 13. *A. erythrosperma*, 29. *A. macrocarpa*, 30. *A. malaccensis*, 33. *A. multinervis*, 41. *A. rubiginosa*, 44. *A. rugulosa* and 52. *A. spectabilis*.

Sect. **Neoaglaia**: (*cf.* Muellner *et al.*, *American Journal of Botany* 92 (2005) 534–543). Intermediate between the other two sections. Calyx with 3 (or rarely 4) broadly obtuse lobes; petals 3–5 (or rarely 6); *anthers* (*rarely* 4)6–10. Fruits small, 1–2.8(–6) × 1.2–2.3(–3.5) cm, dehiscent; when fresh the pericarp usually pink, sometimes carmine-red or yellow in *Aglaia lawii*. Seeds with opaque aril, which when fresh has a red or orange outer skin and white flesh of soft consistency. Species in Sabah and Sarawak belonging to this section are: 3. *A. beccarii*, 24. *A. lawii* and 58. *A. teysmanniana*.

Uses. The timber of several *Aglaia* species is suitable for a variety of uses. The heavier timber (e.g., *A. cucullata* and *A. edulis*) is used in house- and bridge-building, while the moderately heavy timber (e.g., *A. elliptica* and *A. lawii*) is used for light and interior construction. The attractive figure and good working properties of some species make their wood suitable for furniture, flooring, fine finishing, cabinets, turnery, decorative wall panelling, interior trim and face veneer as a substitute for mahogany. The wood is also locally used for general construction, joinery, boat-building, agricultural implements and tool handles. Small-sized poles are often used for fences or poles in local house construction. The arils surrounding the seeds of species with indehiscent fruits are mostly edible (*cf.* PROSEA 5, 2 (1995) 38–54).

Notes. Species distinction in this genus is problematic and is based to a large extent on the structure and distribution of the indumentum. The indumentum is made up of peltate scales or stellate hairs or scales, or a mixture of these. Scales lie in the same plane as the leaflet surface. Peltate scales are round, plate-like structures with an entire (Fig. 1D, 5C, 5I and 6B) or fimbriate (Fig. 2F and 4F) margin, with the rays are visible radiating from the centre of the scale, where it is attached to the leaflet surface. Stellate scales have separate arms radiating from the central point (Fig. 3S and 4B). Stellate hairs also have arms radiating from the centre, but the arms point in any direction from parallel with the plant surface to patent (Fig. 1C, 3C, 5E, 8C, 9B, 10C, 10J and 10Q). The hairs or scales are usually visible with a 20x hand lens, but if a dissecting microscope is available when identifying herbarium specimens, this facilitates observation of key indumentum characters. If neither flowers nor ripe fruits are available, the key allows most species to be identified from a leafy shoot. Hairs and scales are always present on the shoot apex, even if they are absent from the lower surface of the leaflets. Those species most difficult to identify, as well as variable species, appear more than once in the key.

Key to *Aglaia* species

1. Leaves simple (unifoliate).....2
 Leaves compound (imparipinnate, very rarely paripinnate).....8
2. Leaves linear-lanceolate, more than 4x longer than wide.....**40. A. rivularis**
 Leaves not linear-lanceolate, less than 4x longer than wide (rarely one leaflet on a specimen is slightly more than 4x longer than wide).....3
3. Indumentum composed of peltate scales only, stellate hairs absent.....**28. A. luzoniensis**
 Indumentum composed of stellate hairs, rarely interspersed with peltate scales.....4
4. Leaves shiny when dry; intercostal venation subprominent on both sides.....**31. A. meliosmoides**
 Leaves not shiny when dry; intercostal venation may be visible, but not subprominent..5

5. Leaf base cordate.....**46. A. sessilifolia**
 Leaf base rounded or cuneate.....6
6. Indumentum of mature leaves persistent along midrib and, to a lesser extent, the lateral veins below. Fruits curved with a short stipe (narrowed region at base of fruit).....**55. A. sterculioides**
 Indumentum absent or sparse on mature leaves. Fruits not curved and without stipe.....7
7. Leaves narrowly elliptical, yellowish green when dry, apex caudate with acumen to 22 mm long; lateral veins 8–15 on each side of midrib. Ripe fruits ovoid, to 6.9 × 3.9 cm, with up to 8 longitudinal ridges or flanges.....**34. A. neotenica**
 Leaves elliptical or obovate, pale green when dry, apex acute to obtuse; lateral veins 14–22 on each side of midrib. Ripe fruits subglobose, c. 2.2 × 1.9 cm, with one longitudinal ridge around it.....**49. A. simplicifolia**
8. Flowers with 3 calyx lobes and 3 petals. Ripe fruits 3- or 4-locular, dehiscent.....9
 Flowers with more than 3 (usually 5) calyx lobes and more than 3 (usually 5) petals. Ripe fruits 1- or 2(or rarely 3)-locular and indehiscent or 3- or 4-locular and dehiscent (or ripe fruit absent or these characters not easily observed).....19
9. Leaflet lower surface completely covered with a reddish brown indumentum..... **41. A. rubiginosa** (in part)
 Leaflet lower surface not completely covered with such an indumentum.....10
10. Ripe fruits less than 3 cm in diameter.....11
 Ripe fruits more than 3 cm in diameter.....13
11. Indumentum of peltate scales only.....**24. A. lawii** (in part)
 Indumentum either of peltate scales interspersed with stellate hairs or of stellate hairs only.....12
12. Leaflet surface and midrib densely covered with pale stellate hairs below, peltate scales absent, base asymmetrical, margin plane or slightly recurved; petiolules 1–2 cm long. Staminal tube cup-shaped, c. 1.1 × 1.3 mm. Seeds obovoid.....**58. A. teysmanniana** (in part)
 Leaflet surface and midrib sparsely covered with pale peltate scales below, sometimes interspersed with stellate hairs or scales, base symmetrical, margin recurved and undulate; petiolules 0–1 cm long. Staminal tube obovoid, 1.4–2.5 × 1.3–2.5 mm. Seeds subglobose.....**3. A. beccarii** (in part)
13. Leaves with 10–12 lateral leaflets on each side of rachis; leaflets with 20–25 lateral veins on each side of midrib.....**33. A. multinervis** (in part)
 Leaves with up to 10 lateral leaflets on each side of rachis; leaflets with up to 19 lateral veins on each side of the midrib.....14
14. Leaflet margins recurved, upper surface often shiny when dry.....**13. A. erythrosperma** (in part)
 Leaflet margins not recurved, upper surface dull when dry.....15

15. One or both leaflet surfaces rugulose.....16
 Leaflet surfaces not rugulose.....18
16. Small tree (to 12 m tall). Leaflets usually attenuate at base (occasionally rounded)...
**44. A. rugulosa** (in part)
 Mature tree usually more than 12 m tall. Leaflets rounded or cuneate at base.....17
17. Intercostal venation not subprominent on lower leaflet surface. Flowers obovoid, 2–3.5
 \times 1.6 mm; staminal tube subglobose, *c.* 1.5 mm diameter, anthers 6. Fruits obovoid, to
 7.5×7.3 cm; when dry the pericarp longitudinally wrinkled and moulded around the
 seeds.....**29. A. macrocarpa** (in part)
 Intercostal venation subprominent on lower leaflet surface. Flowers ellipsoid, 5–7 \times 3–6
 mm; staminal tube cup-shaped, *c.* 2.5 mm diameter, anthers 6–9. Fruits ellipsoid, 8–10
 \times 6–8 cm; pericarp not so.....**52. A. spectabilis** (in part)
18. Midrib sparsely to densely covered with minute pale brown or almost white stellate hairs
 or scales.....**30. A. malaccensis** (in part)
 Midrib sparsely to densely covered with minute dark reddish brown peltate scales (which
 sometimes resemble minute pits), sometimes interspersed with pale grey peltate
 scales.....**29. A. macrocarpa** (in part)
19. Leaflet lower surface without or with few hairs or scales; reticulation of intercostal veins
 continuous and subprominent on one or both surfaces.....20
 Leaflet lower surface sparsely to densely covered with scales or stellate hairs; if without
 hairs and/or scales then reticulation of intercostal veins not continuous nor subprominent
 on either surface22
20. Leaflets with the intercostal venation subprominent on the lower
 surface.....**8. A. cumingiana** (in part)
 Leaflets with the intercostal venation subprominent on both surfaces.....21
21. Lateral leaflets 5–7 on each side of rachis, dull when dry.....**25. A. laxiflora** (in part)
 Lateral leaflets 1–3(–5) on each side of rachis, slightly shiny when
 dry.....**36. A. oligophylla** (in part)
22. Leaflets linear-lanceolate or narrowly elliptical, mostly at least 5x longer than
 wide.....23
 Leaflets ovate, elliptical, oblong, oblong-obovate, obovate, lanceolate or oblanceolate,
 mostly less than 5x longer than wide.....26
23. Leaflets at least 10x longer than wide.....**1. A. angustifolia**
 Leaflets 4 to 5, and occasionally to 10x longer than wide.....24
24. Leaflets with stellate hairs and scales numerous on the lower surface or densely covering
 the midrib and numerous on the lower surface.....**4. A. bullata**
 Leaflets with stellate hairs or scales or peltate scales few on the lower surface or densely
 covering the midrib and few or absent on the lower surface.....25

25. Leaflets below with reddish brown stellate hairs or scales densely covering the midrib; blades 11–25 × 1–4.5 cm; lateral veins 6–19 on each side of midrib. Fruits indehiscent, globose, to 2.5 × 2.4 cm.....**22. A. lancifolia**
 Leaflets below with a few to dense cover of peltate fimbriate scales on the midrib; blades 7–12 × 1.8–2 cm; lateral veins 20–25 on each side of midrib, alternating with less distinct shorter veins. Fruits dehiscent, subglobose or ovoid with a small beak, to 6 × 5 cm.....**33. A. multinervis** (in part)
26. Indumentum dense, composed of white or pale brown hairs or scales which nearly or totally conceal leaflet lower surface.....27
 Indumentum reddish brown or, if pale, not totally concealing leaflet lower surface.....32
27. Indumentum composed of hairs which have a central rachis and several whorls of arms radiating from it.....28
 Indumentum composed of stellate hairs or peltate scales.....29
28. Twigs and rachis channelled. Lateral leaflets 9–13 on each side of rachis. Indumentum on lower leaflet surface so dense that the surface is barely visible between the hairs even when using a hand lens. Fruits to 8 × 8.5 cm.....**37. A. pachyphylla** (in part)
 Twigs and rachis terete. Lateral leaflets (4 or) 5–9 on each side of rachis. Indumentum on lower leaflet surface dense but the surface visible between the hairs when using a hand lens. Fruits to 5 × 5.6 cm.....**19. A. grandis**
29. Leaflet upper surface rugose.....**53. A. squamulosa** (in part)
 Leaflet smooth on both surfaces.....30
30. Indumentum dense on lower leaflet surface, consisting of very pale brown peltate scales interspersed with few to numerous brown peltate scales.....**2. A. argentea**
 Indumentum dense on lower leaflet surface, consisting of white stellate scales interspersed with few to numerous brown stellate hairs.....31
31. Lateral leaflets 4 or 5 on each side of rachis; blades ovate, elliptical or obovate; lateral veins 11–17 on each side of midrib; intercostal venation visible above, slightly prominent below; petiolules to 0.5 cm long. Fruits c. 2 × 2 cm, densely covered with dark brown stellate hairs.....**50. A. soepadmoi**
 Lateral leaflets 9–13 on each side of rachis; blades oblong, lanceolate or oblanceolate; lateral veins 24–39 on each side of midrib; intercostal venation subprominent or faint but visible on both surfaces; petiolules 1–2.5 cm long. Fruits to 8 × 8.5 cm, glabrescent.....**37. A. pachyphylla** (in part)
32. Leaflet lower surface densely covered with reddish brown or orange-brown hairs or scales, the surface not or barely visible.....33
 Hairs or scales absent from leaflet lower surface or, when present, the surface readily visible.....35
33. Leaflet lower surface with numerous stellate hairs, interspersed with paler hairs which have one or few ascending arms, the surface barely visible.....**20. A. hiernii** (in part)
 Leaflet lower surface densely covered with stellate or peltate scales, sometimes interspersed with stellate hairs, the surface not visible.....34

34. Twigs densely covered with dark reddish brown peltate scales. Lateral leaflets 4 or 5 on each side of rachis; leaflet lower surface with dark reddish brown entire peltate scales. Flowers pentamerous. Fruits indehiscent, with a long narrow beak to 1.5 cm long and short broad stalk to 5 mm long.....**9. A. densisquama**
Twigs densely covered with reddish brown or dark brown stellate hairs. Lateral leaflets 9–12 on each side of rachis; leaflet lower surface with reddish brown stellate scales. Flowers trimerous. Fruits dehiscent, without such beak and stalk.....**41. A. rubiginosa** (in part)
35. Indumentum mainly consisting of peltate scales, sometimes interspersed with stellate scales.....36
Indumentum mainly consisting of stellate hairs or scales, peltate scales few or absent.....60
36. Indumentum comprising peltate scales only.....37
Indumentum comprising peltate and stellate scales (or with at least some of the scales with a long fimbriate margin).....57
37. Peltate scales densely covering leaflet lower surface.....38
Peltate scales almost absent to numerous on leaflet lower surface.....39
38. Twigs, inflorescence branches and leaflet lower surface covered with yellowish brown or orange-brown peltate scales, all less than 0.25 mm diameter. Fruits $2.5\text{--}3.5 \times 2\text{--}2.5$ cm.....**A. crassinervia** (in part)
Twigs, inflorescence branches and leaflet lower surface thickly covered with large, shiny, peltate scales at least some of which are 0.25 mm or more diameter. Fruits $5\text{--}5.7 \times 3.5\text{--}4.7$ cm.....**53. A. squamulosa** (in part)
39. Scales few to numerous on leaflet lower surface.....40
Scales absent from leaflet lower surface but sometimes densely covering the midrib below and immediately adjacent to it, occasionally also on the lateral veins.....48
40. Indumentum comprising orange-brown, pale brown or almost white peltate scales....41
Indumentum comprising, at least partly, reddish brown peltate scales.....46
41. Leaflets markedly asymmetrical, terminal ones often folded at the base forming a pocket.....**7. A. cucullata** (in part)
Leaflets only slightly asymmetrical, terminal ones not as above.....42
42. Peltate scales numerous and evenly distributed on leaflet lower surface, sometimes visible to the naked eye as tiny dots.....43
Peltate scales few and not evenly distributed on leaflet lower surface or, if they are, not visible to the naked eye.....44
43. Leaflet lower surface with numerous large dark orange-brown peltate scales and the surface visible to the naked eye as evenly distributed spots. Fruits $c. 4 \times 4$ cm.....**60. A. variisquama**
Leaflet lower surface with numerous small yellowish brown or orange-brown peltate scales which have an entire or fimbriate margin or almost stellate scales and the surface visible only with a hand lens. Fruits $2.5\text{--}3.5 \times 2\text{--}2.5$ cm.....**6. A. crassinervia** (in part)

44. Fruits dehiscent.....**24. A. lawii** (in part)
Fruits indehiscent.....45
45. Leaflets below with a few to numerous small, reddish brown, pale brown or orange-brown stellate hairs and scales or peltate scales on the midrib only. Fruits 3.2–5 × 3.1–4.2 cm, usually subglobose with an apical depression, 3-locular but sometimes the seed failing to develop in 1 or 2 of the locules; pericarp thick, woody when dry.....**10. A. edulis** (in part)
Leaflets below with large pale brown or orange-brown peltate scales with entire or fimbriate margin on the midrib and few to numerous on the surface. Fruits 1.1–2.5 × 1.3–1.5 cm, subglobose, ellipsoid or obovoid without an apical depression, 2-locular; pericarp thin when dry.....**11. A. elaeagnoides**
46. Staminal tube with a narrow pin-prick aperture c. 0.3 mm diameter with an entire margin; anthers included.....**8. A. silvestris**
Staminal tube with the aperture more than 0.3 mm diameter, margin shallowly lobed; anthers protruding through the aperture of the staminal tube.....47
47. Leaflets narrowly elliptical or narrowly obovate; with numerous scales on the lower surface. Fruits obovoid, without dehiscent lines.....**51. A. speciosa**
Leaflets ovate or elliptical or sometimes obovate, with few to numerous scales on the lower surface. Fruits ellipsoid, with a longitudinal ridge along which the pericarp splits when pressure is applied.....**21. A. korthalsii**
48. Scales densely covering the midrib on leaflet lower surface and immediately adjacent to the midrib, occasionally also on the lateral veins.....49
Scales sparse or more or less absent from leaflet lower surface.....52
49. Scales more than 0.2 mm diameter, orange-brown, reddish brown or almost white, with a tendency to flake off.....**23. A. lancilimba**
Scales less than 0.2 mm diameter or, if larger, dark reddish brown or purplish brown and adhering closely to the leaflet surface.....50
50. Leaflet lower surface with purplish brown fimbriate peltate scales densely covering the midrib and more or less absent from the rest of the surface.**17. A. glabrata** (in part)
Leaflet lower surface with dark reddish brown peltate scales numerous on the midrib.....51
51. Lateral leaflets (3 or)4–6(or 7) on each side of rachis; stellate scales absent; petiolules 0.5–1 cm long.....**45. A. scortechinii**
Lateral leaflets 1 or 2 (or rarely 3) on each side of rachis; some stellate scales interspersed among the peltate scales; petiolules 2–3.5 cm long.....**35. A. odoratissima** (in part)
52. Leaflet veins usually brown or black when dry. Petals 5. Fruit indehiscent.....53
Leaflet veins rarely black when dry. Petals usually 3 (rarely 4). Fruit dehiscent.....54
53. Leaves to 30 cm long; lateral leaflets opposite; lateral veins of leaflets 6–7 on each side of midrib. Calyx outside without hairs or scales. Fruits without longitudinal ridge.....**18. A. glabriflora**
Leaves 30–83 cm long; lateral leaflets alternate; lateral veins of leaflets 9–

- 13 on eachside of midrib. Calyx outside densely covered with peltate scales.
Fruits with a longitudinal ridge.....**26. A. leptantha**
54. Leaflets markedly asymmetrical, the terminal ones sometimes folded at the base forming a pocket.....**7. A. cucullata** (in part)
Leaflets only slightly asymmetrical, the terminal ones not as above.....55
55. Ripe fruits to 2.9 cm diameter.....**24. A. lawii** (in part)
Ripe fruits more than 3.5 cm diameter.....56
56. Lateral leaflets 10–12 on each side of rachis, lanceolate; lateral veins 20–25 on each side of midrib, indistinct below; petiolules to 1 cm long. Fruits to 6 × 5 cm.....**33. A. multinervis** (in part)
Lateral leaflets 4–7 on each side of rachis, ovate, obovate, elliptical or oblanceolate; lateral veins 6–15 on each side of midrib, subprominent below; petiolules 1.5–2 cm long. Fruits to 7.5 × 7.3 cm.....**29. A. macrocarpa** (in part)
57. Leaflets not pale yellowish green when dry.....**35. A. odoratissima** (in part)
Leaflets pale yellowish green when dry or with whitish green or orange veins.....58
58. Fruit dehiscent (indicated in unripe fruits by three longitudinal ridges on the pericarp).....**3. A. beccarii** (in part)
Fruit indehiscent (any longitudinal markings on the fruits being slight depressions rather than ridges).....59
59. Leaflets pale brown or yellowish brown when dry. Fruits usually subglobose and 3-locular but sometimes the seed failing to develop in 1 or 2 of the locules.....**10. A. edulis** (in part)
Leaflets yellow or yellowish green when dry. Fruits usually pear-shaped, sometimes subglobose and 2-locular.....**27. A. leucophylla** (in part)
60. Leaflet lower surface with a sparse to dense cover of stellate hairs or scales; when sparse, some hairs or scales occurring evenly distributed between the veins and visible to the naked eye.....61
Leaflet lower surface with or without a few hairs or with a dense cover of hairs on the midrib only and with a few to many stellate scales (visible only with a hand lens) unevenly scattered on the rest of the surface.....75
61. Intercostal venation subprominent on both surfaces when dry. Twigs and sometimes other parts of plant with some hairs which have a central rachis and several whorls of arms radiating from it.....**39. A. ramotricha**
Intercostal venation faint on both surfaces or prominent below. All hairs on plant parts lacking a central rachis.....62
62. Hairs pale yellowish brown or if reddish brown then flower trimerous.....63
Hairs reddish brown or brown, or if pale brown then flower pentamerous.....64
63. Peltate scales absent. Petiolules 1–2 cm long.....**58. A. teysmanniana** (in part)
Peltate scales present, at least on the shoot apex. Petiolules 0–1 cm long.....**A. beccarii** (in part)

64. Hairs on lower leaflet surface numerous and with the arms of adjacent hairs overlapping, but leaving the surface of the leaflet visible.....65
Hairs on leaflet lower surface few or at least with the arms not usually overlapping...
.....69
65. Hairs compact, arms all more or less equal in length *c.* 0.5 mm, brown, densely covering the midrib and densely covering or scattered on the rest of the leaflet lower surface.....66

Hairs large and spreading, arms unequal in length to 1 mm long and in one species (*A. rufibarbis*) more than 1 mm, usually reddish brown and numerous on leaflet lower surface.....67
66. Lower surface of leaflet densely covered with persistent brown stellate hairs and scales. Petiolules to 3.5 cm long. Fruits *c.* 1.7–2.2(–3) × 1.4–2(–2.7) cm; pericarp thin *c.* 2 mm thick, hard and brittle or woody.....**47. A. sexipetala** (in part)
Lower surface of leaflet densely covered with deciduous brown stellate hairs leaving many pits and an uneven indumentum most dense near midrib and veins. Petiolules to 2 cm long. Fruits *c.* 4 × 3.8 cm; pericarp to 4 mm thick, soft.....**15. A. forbesii** (in part)
67. Stellate hairs with long arms, some of which over 1 mm long.....**42. A. rufibarbis**
Stellate hairs with arms up to 1 mm long.....68
68. Lower surface of leaflet with numerous dark reddish brown stellate hairs, the arms of adjacent hairs overlapping, interspersed with some pale brown hairs which have one or few ascending arms. Fruits to 4 × 3 cm, 1-locular, with a hard woody pericarp 2–4 mm thick.....**20. A. hiernii** (in part)
Lower surface of leaflet with numerous reddish brown or orange-brown stellate hairs, the arms of adjacent hairs usually overlapping, interspersed with pale brown stellate hairs, each with several ascending arms. Fruits to 3 × 2.2 cm, 2-locular, with a brittle pericarp less than 2 mm thick.....**59. A. tomentosa** (in part)
69. Leaflet lower surface with indumentum comprising few fimbriate peltate scales and stellate hairs. Fruits to 4 mm diameter, hairs few or absent.....**38. A. palembanica**
Leaflet lower surface without peltate scales. Fruits *c.* 1 cm or more diameter, with dense indumentum.....70
70. Lateral leaflets usually more than 5 on each side of rachis; arms of adjacent hairs on lower surface not overlapping.....71
Lateral leaflets rarely more than 5 on each side of rachis, (if so, the indumentum dense and arms of adjacent hairs on lower surface overlapping).....72
71. Hairs and scales mostly reddish brown. Fruits subglobose, to 1.2 cm diameter, 1-locular.....**43. A. rufinervis**
Hairs and scales mostly orange-brown. Fruits pear-shaped or subglobose, to 2.7 cm diameter, 2-locular.....**27. A. leucophylla** (in part)
72. Leaflets to 6 cm wide, elliptical or oblong; stellate hairs compact, distributed evenly on lower leaflet surface, visible to the naked eye as brown dots, the arms of adjacent hairs and scales not overlapping.....**14. A. exstipulata**

- Leaflets to 11.5 cm wide, mostly obovate, individual hairs not visible as evenly spaced brown dots, the arms of adjacent hairs and scales overlapping.....73
73. Tree usually unbranched.....**57. A. tenuicaulis** (in part)
Tree branching several or many times when mature.....74
74. Leaflets with numerous pale stellate scales on the lower surface, interspersed with reddish brown stellate hairs with arms of different lengths. Fruits 2-locular.....**59. A. tomentosa** (in part)
Leaflets with numerous pale brown or reddish brown stellate hairs, that of the lower surface with arms of similar lengths. Fruits 1-locular.....**57. A. tenuicaulis** (in part)
75. Leaflet lower surface with numerous stellate or peltate scales.....76
Leaflet lower surface with hairs or scales few between the veins when mature, but sometimes densely covering the midrib.....79
76. Stellate scales on lower leaflet surface interspersed with compact stellate hairs.....**47. A. sexipetala** (in part)
Stellate scales on lower leaflet surface sometimes interspersed with peltate scales, stellate hairs absent.....77
77. Fruit dehiscent.....**3. A. beccarii** (in part)
Fruit indehiscent.....78
78. Scales all of one type. Fruits 1(rarely 2)-locular.....**6. A. crassinervia** (in part)
Stellate and peltate scales present together. Fruits 2-locular.....**7. A. leucophylla** (in part)
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Stellate hairs or scales either minute or almost totally absent from the midrib below and from the rest of the leaflet lower surface.....91
80. Leaflets more or less sessile or with a short petiolules rarely more than 1 cm long; the basal ones much smaller than the rest and subrotund.....**6. A. subsessilis** (in part)
Leaflets not sessile, the basal ones only slightly smaller than the rest and of similar shape.....81
81. Intercostal venation subprominent on lower surface and often on upper surface of leaflet.....82
Intercostal venation inconspicuous or sometimes visible but faint on lower surface.....83
82. Lateral leaflets 5–7 on each side of rachis, with pale brown stellate scales few to numerous on the midrib below; intercostal venation subprominent on both surfaces. Fruits ellipsoid or obovoid, 5–6 × 3.5 cm.....**25. A. laxiflora** (in part)
Lateral leaflets 1–5 on each side of rachis, with pale yellowish brown stellate hairs

- absent to numerous on the midrib below; intercostal venation visible above, subprominent below. Fruits subglobose, to 3.4×3.7 cm.....**36. *A. oligophylla*** (in part)
83. Tree unbranched or rarely with few branches. Leaflets above shiny when dry.....**5. *A. coriacea***
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84. Leaflet surfaces with prominent pits.....85
Leaflet surfaces not or faintly so pitted.....87
85. Lateral leaflets 2–4 on each side of rachis.....**17. *A. glabrata*** (in part)
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86. Leaves to 42 cm long; petioles to 8 cm long; leaflets 1.3–2.2(–4.5) cm wide, yellowish green or brown when dry; intercostal venation visible to subprominent; petiolules to 0.8 cm long. Fruits to 2.5 cm long.....**16. *A. foveolata***
Leaves to 100 cm long; petioles to 35 cm long; leaflets 3.5–9 cm wide, blackish green when dry; intercostal venation barely visible; petiolules 1.5–2 cm long. Fruits to 4 cm long.....**15. *A. forbesii*** (in part)
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88. Fruits dehiscent, $2-2.2 \times 2.1-2.5$ cm.....**2. *A. beccarii*** (in part)
Fruits indehiscent, $3.2-5 \times 3.1-4.2$ cm.....**10. *A. edulis*** (in part)
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90. Lateral leaflets (2 or)3–6 on each side of rachis, subopposite or almost alternate. Fruits obovoid or ellipsoid, with one longitudinal ridge around it.....**12. *A. elliptica***
Lateral leaflets 1 or 2 on each side of rachis, opposite. Fruits narrowly ellipsoid, with 10 longitudinal ridges from base to apex.....**56. *A. subsessilis*** (in part)
91. Petals 5 (or 6). Leaflets yellow or yellowish green; lateral veins black or dark brown when dry.....92
Petals 3. Leaflets brown, greenish brown, purplish brown or orange-brown; lateral veins usually the same colour as the leaflet surface.....96
92. Leaflets greyish brown or blackish green when dry, particularly the veins; scales pale grey or greyish brown.....93
Leaflets yellow or yellowish green when dry; hairs or scales pale brown, reddish brown or golden-brown.....94
93. Leaves to 100 cm long; petioles to 35 cm long; leaflets $8.5-21 \times 3.5-9$ cm, lateral veins 12–24 on each side of midrib. Fruits c. 4×3.8 cm.....**15. *A. forbesii*** (in part)
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94. Inflorescences delicate; peduncles, rachis and branches flattened, these and calyces with a very few pale brown stellate scales.....**8. *A. cumingiana*** (in part)
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 Lateral leaflets 1 or 2 on each side of rachis, base cuneate or attenuate, margins recurved when dry; when young, lower surface densely covered with reddish brown stellate hairs, becoming more or less glabrous when older.....**32. *A. monozyga***
96. Leaflet surfaces dull and pitted, with tiny stellate hairs sometimes frequent on lower surface; intercostal venation subprominent.....**52. *A. spectabilis*** (in part)
 Leaflet surfaces smooth or rugulose but not pitted, stellate hairs almost absent from lower surface; reticulation of intercostal veins faint.....97
97. Leaflets 2–4(–6.5) cm wide, lower surface usually purplish brown and smooth when dry.....**30. *A. malaccensis*** (in part)
 Leaflets (4–)6–12 cm wide, lower surface not purplish brown when dry.....98
98. Lateral leaflet 3–5 on each side of rachis, surfaces smooth or only slightly rugulose, base usually rounded, sometimes cuneate. Fruits subglobose, *c.* 10 cm diameter; pericarp to 1.5 cm thick.....**13. *A. erythrosperma*** (in part)
 Lateral leaflet 6–7 on each side of rachis, surfaces rugulose, base usually attenuate, sometimes cuneate. Fruits ellipsoid or obovoid, to 3.6 cm diameter; pericarp 2–5 mm thick.....**44. *A. rugulosa*** (in part)

1. *Aglaia angustifolia* (Miq.) Miq.

(Latin, *angustus* = narrow, *folium* = leaf; referring to the narrow leaflets)

Sect. *Aglaia*

Ann. Mus. Lugd. Bat. 4 (1868) 55; Merrill *op. cit.* (1921) 321; Masamune *op. cit.* 370; Corner, Gard. Bull. Sing. Suppl. 1 (1978) 131; Anderson *op. cit.* (1980) 247; Pannell *op. cit.* (1989) 211, *op. cit.* (1992) 337, *op. cit.* (1995) 309; Whitmore, Tantra & Sutisna *op. cit.* 220; Turner, Gard. Bull. Sing. 47 (1995) 336; Coode *et al.* (eds.) *op. cit.* 200. **Basionym:** *Hartighsea angustifolia* Miq., Fl. Ind. Bat. Suppl. 1 (1861) 196, 504. **Lectotype** (Pannell, 1992): *Teijsmann HB 689*, Sumatra, Loeboe-Aloeng (U [Acc. No. 39273]; isoelectotype L [Acc. No. 9081321277]). **Synonyms:** *Hearnia beccariana* C.DC. in A.P. de Candolle, Mon. Phan. 1 (1878) 629; *Aglaia beccariana* (C.DC.) Harms *op. cit.* 298, Merrill *op. cit.* (1921) 321, Masamune *op. cit.* 370, Anderson *op. cit.* (1980) 247; *Aglaia stenophylla* Merr., Philipp. J. Sci., Bot. 11 (1916) 185.

Small tree to 7 m tall, 10 cm diameter, *unbranched* or rarely with a few branches. **Bark** smooth, greyish green or greyish brown or pale brown, sometimes with large lenticels or shallow vertical cracks; inner bark yellow-brown, pale orange or brown; latex white. **Sapwood** pale yellowish brown, becoming orange or brown towards the centre. **Twigs** stout, *densely covered with reddish brown or orange-brown stellate hairs with arms to 1 mm long*. **Leaves** *imparipinnate*, to 100 cm long; petioles to 15 cm long; *leaflets below densely*

covered with stellate hairs on the surface and midrib, sometimes interspersed with either smaller paler hairs with fewer arms or stellate scales; lateral leaflets 9–12(–17) on each side of rachis, subopposite; *blades linear-lanceolate*, 8.5–34 × 0.5–4 cm, base rounded or subcordate, asymmetrical, margin recurved, apex caudate, acumen acute; midrib prominent below; lateral veins 18–31 on each side of midrib, curved upwards, subprominent below; *intercostal venation usually faintly visible*; petiolules 0–0.5 cm long. **Inflorescences** densely covered with brown stellate hairs; males to 35 cm long, 24 cm wide; females to 10 cm long. **Flowers** 1.1–1.2 × 1.2–1.5 mm; *calyx deeply divided into 5 elliptical lobes* with numerous stellate hairs outside; *corolla c.* 1 × 1.5 mm, *divided almost to the base into 5 subrotund lobes*, bright yellow; staminal tube *c.* 0.8 × 1 mm, pale yellow, *anthers* 5, ovoid, *c.* 0.2 × 0.2 mm; ovary depressed globose, *c.* 0.2 × 0.2 mm, locule 1, containing 1 ovule, stigma *c.* 0.3 × 0.2 mm. **Fruits indehiscent, 1-locular, subglobose, *c.* 1.2 × 1 cm, yellowish brown; pericarp *c.* 0.5 mm thick, fairly soft. **Seed** 1, *c.* 1 × 0.8 × 0.6 cm; aril thin, *c.* 0.2 mm thick, translucent.**

Vernacular names. Sarawak—*pasak bumi* (Malay), *segera* (Iban).

Distribution. Sumatra, Peninsular Malaysia (Johor), Anambas and Natuna Islands, Borneo and the Philippines. In Borneo, known only in Sarawak from Kuching, Lundu, Simunjan, Sri Aman and Song districts (e.g., *Mabberley 1605*, *Pennington 7962*, *Pennington 7973*, *S 42274*, *S 42275* and *S 42859*), Brunei (e.g., *S 21583*, *S 21584* and *SAN 17565*) and Kalimantan (e.g., *Nooteboom 4776*).

Ecology. In mixed dipterocarp forest, sometimes occurring along rivers and in *kerangas* forest, at altitudes to 1000 m.

2. *Aglaia argentea* Blume

(Latin, *argenteus* = silvery; the lower surface of leaflets)

Sect. *Aglaia*

Bijdr. Fl. Ned. Ind. (1825) 170; Miquel *op. cit.* (1861) 543, *op. cit.* (1868) 54; King *op. cit.* 70; Koorders & Valeton, Atl. Baum. Java, 1 (1913) t. 151; Merrill *op. cit.* (1921) 321; Ridley *op. cit.* (1922) 405; Masamune *op. cit.* 370; Backer & Bakhuizen *f. op. cit.* 129; Anderson *op. cit.* (1980) 247; Pannell *op. cit.* (1989) 211, *op. cit.* (1992) 125, *op. cit.* (1995) 237; Whitmore, Tantra & Sutisna *op. cit.* 220; PROSEA *op. cit.* (1995) 42; Turner *op. cit.* 336; Coode *et al.* (eds.) *op. cit.* 200; Beaman & Anderson *op. cit.* 119. **Lectotype** (Pannell, 1992): *Blume s.n.*, Java, Mt. Salak (L [Acc. No. 9108162]). **Synonyms:** *Aglaia hypoleuca* Miq. *op. cit.* (1861) 197, 507; *Aglaia argentea* Blume var. *hypoleuca* (Miq.) Miq. *op. cit.* (1868) 55; *Aglaia argentea* Blume var. *borneensis* Miq. *op. cit.* (1868) 55; *Aglaia argentea* Blume var. *curtisii* King *op. cit.* 71; *Aglaia multifoliola* Merr., Philip. J. Sci., Bot. 9 (1915) 534, Masamune *op. cit.* 372; *Aglaia discolor* Merr. *op. cit.* (1929) 130, Masamune *op. cit.* 371, Anderson *op. cit.* (1980) 247.

Tree to 25 m tall, to 60 cm diameter, branched; buttresses to 1 m tall, 1 m out and 4 cm thick. **Bark** brown or grey, smooth; inner bark pale yellow, brown or reddish brown; latex white, when present. **Sapwood** white, pale brown, brown or reddish brown. **Twigs** stout, *densely covered with brown peltate scales with a darker centre*. **Leaves** imparipinnate, to 112 cm long; petioles to 41 cm long; *leaflets below thickly covered with very pale brown*

peltate scales interspersed with a few to numerous brown peltate scales; lateral leaflets 4–6 on each side of rachis, subopposite; *blades smooth on both surfaces, elliptical or oblong, 6.5–31 × 2–7 cm*, base rounded or subcorded, asymmetrical, margin planar, apex acuminate, acumen acute, to 10 mm long; midrib impressed above, prominent below; lateral veins 9–20 on each side of midrib; *intercostal venation invisible on both surfaces*; petiolules 0.5–1 cm long on lateral leaflets, 1–1.2 cm long on terminal leaflets. **Inflorescences** to 60 cm long and wide, densely covered with brown peltate scales. **Flowers** ellipsoid, 2.5–3 × 1.6–2 mm, sessile; *calyx* thickly covered with scales like that of the leaves, *deeply divided into 5 rounded lobes*; *petals* 5; staminal tube obovoid, 1.6–1.8 × 1.2–1.3 mm, *anthers* 5, ovoid, 0.7–0.8 × 0.5 mm; ovary depressed globose, 0.3–0.5 × 0.4–0.9 mm, locules 3, each containing one ovule, stigma ovoid with a truncate apex, 0.6–0.8 × 0.5–0.6 mm, longitudinally ridged. **Fruits** *indehiscent, 2(or 3)-locular*, each locule containing 0 or 1 seed, densely covered with scales like that of the twigs, sometimes glabrescent, ovoid or obovoid, 3–3.5 × 2–3 cm; stalk to 0.5 cm long; pericarp yellow or brown; latex white. **Seeds** completely surrounded with a soft, white, sweet or sweet-sour aril.

Vernacular names. Sabah—*koping-koping* (Dusun), *lantupak* (Dusun Kinabatangan). Sarawak—*segera* (Iban).

Distribution. Nicobar Islands, Thailand, Sumatra, Peninsular Malaysia, Borneo, the Philippines, Java, Nusa Tenggara, Sulawesi, Maluku, New Guinea, Solomon Islands and Australia (Cape York Peninsula). In Sabah, known from Beaufort, Kinabatangan, Kudat, Lahad Datu, Labuk Sugut, Sandakan, Tawau and Tenom districts (e.g., *SAN 18392*, *SAN 46251*, *SAN 51320*, *SAN 89989* and *SAN 120654*) and in Sarawak from Bau, Kuching, Lundu, Marudi and Mukah districts (e.g., *S 22855*, *S 22956*, *S 23660*, *S 37990* and *S 42440*). Also occurring in Brunei (e.g., *Argent 9159* and *SAN 17385*) and Kalimantan (e.g., *Church et al. 1908*, *Church & Mahyar 5495*, *Jarvie & Ruskandi 6509*, *Kostermans 21290* and *Wiriadinata 803*).

Ecology. In riverine and *kerangas* forests, on sandy or red soils, and limestone. Scattered to locally rather common, at altitudes to 1200 m. The aril is eaten by monkeys, hornbills and children.

3. *Aglaia beccarii* C.DC.

Fig. 1, Plate 1A.

(Odoardo Beccari, 1843–1920, Italian explorer and botanist)

Sect. *Neoaglaia*

Bull. Herb. Boiss. 2 (1894) 579; Merrill *op. cit.* (1921) 321; Masamune *op. cit.* 370; Whitmore, Tantra & Sutisna *op. cit.* 220; Beaman & Anderson *op. cit.* 119. **Type:** *Beccari PB 3297*, Borneo, Sarawak (holotype G; isotype G). **Synonyms:** *Amoora korthalsii* Miq. *op. cit.* (1868) 36; *Aglaia brachybotrys* Merr., Philip. J. Sci., Bot. 7 (1912) 274; *Amoora curtispica* Gibbs, J. Linn. Soc., Bot. (1914) 63.

Tree to 15(–25) m tall, to 30 cm diameter, *branched*; buttresses (if present) upwards to 90 cm and outwards to 45 cm; sometimes flowering at 2.5 m tall. **Bark** smooth or with shallow depressions or horizontal bands, greyish brown, greenish brown, or white; inner bark pale green, pale yellow, pale orange-brown, white, red or brownish grey. **Sapwood** pale brown or white, pink towards the heartwood; latex white. **Twigs** *with dense orange-brown peltate or stellate scales, sometimes interspersed with stellate hairs*, glabrescent. **Leaves** *imparipinnate*, 15–40 cm long; petioles 3–7 cm long; rachis *sometimes ridged or with*

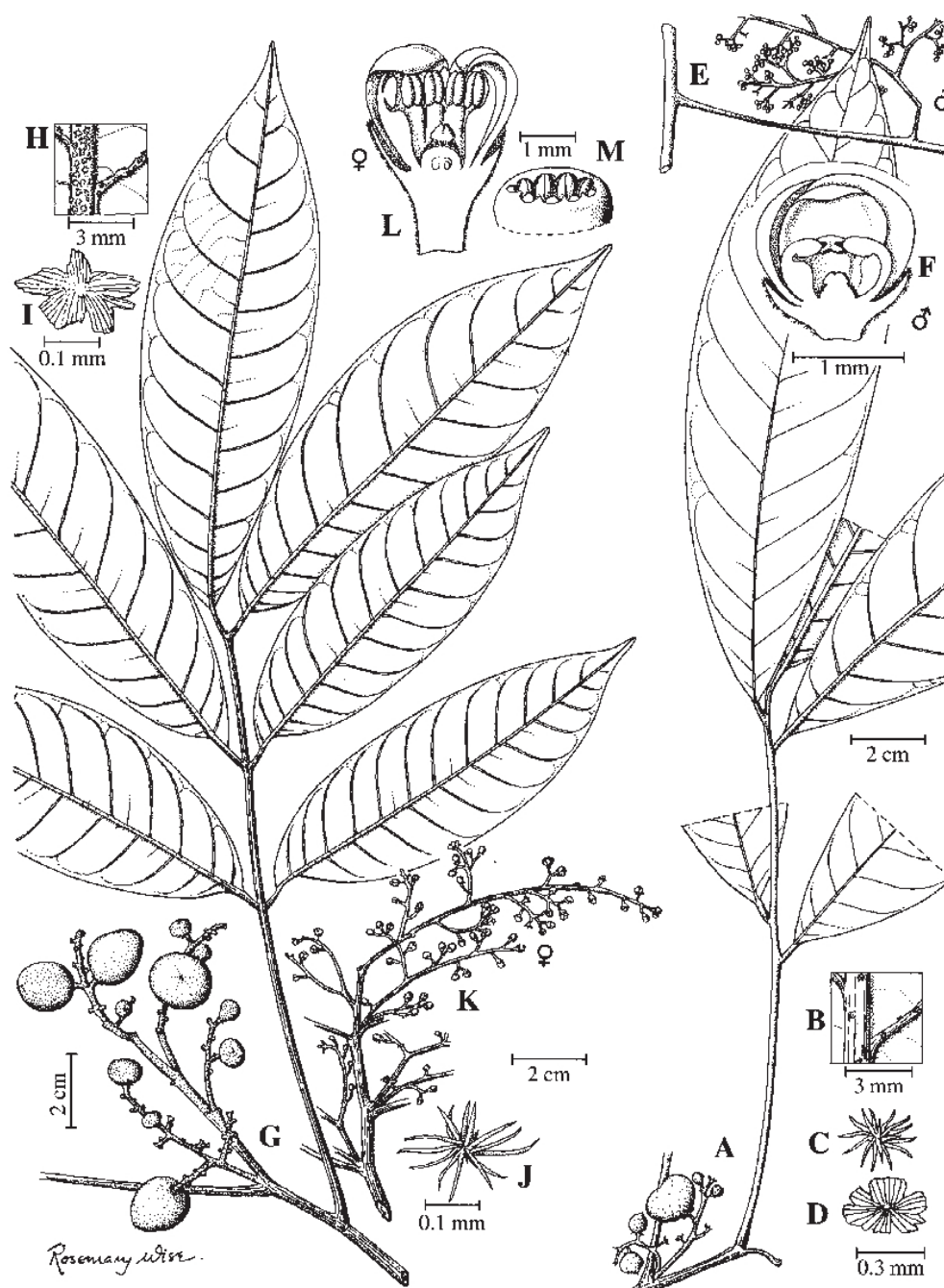


Fig. 1. *Aglaia beccarii*. A, fruiting leafy twig of small tree; B, detail of midrib and lateral vein on the lower leaflet surface showing indumentum; C, stellate hair; D, peltate scale; E, part of male inflorescence; F, longitudinal section of male flower; G, fruiting leafy twig of large tree; H, detail of midrib and lateral vein on the lower leaflet surface showing indumentum; I, peltate scale; J, stellate hair; K, part of female inflorescence; L, longitudinal section of female flower; M, detail of aperture of staminal tube. (A–D from Beaman 7262, E–F from Beaman et al. 10613, G–J from Pennington 7925, K–M from Pennington 7943.)

narrow, foliolate wing to 3 mm wide; petioles, rachis and petiolules without or with few scales or hairs like that of the twigs; leaflets pale green or yellow when dry, surfaces not or only faintly pitted, above with few peltate or stellate scales or stellate hairs on the midrib, below with few to numerous peltate or stellate scales or stellate hairs on the surface, midrib and lateral veins; lateral leaflets 2–4 on each side of rachis; blades elliptical, 6.5–32 × 3–11.5(–19.5) cm, base cuneate, symmetrical, margin recurved and undulate, apex acute, acuminate to caudate, acumens to 15 mm long; midrib and lateral veins prominent below, sometimes pale green when dry; lateral veins 6–21 on each side of midrib; intercostal venation faint above, faint or subprominent below; petiolules 0–1 cm long. Inflorescences 4–17 cm long and 5–18 cm wide. Flowers subglobose, (1.5–)1.8–3 × (1.6–)1.7–3.5 mm; pedicels 1–1.5 mm long; calyx (0.5–)0.7–1.5 mm tall, divided into 3 or 4 (or rarely 6) lobes; corolla c. 2.5–2.8 × 1.8–3 mm, divided into 3–5 lobes, joined to the staminal tube at base, staminal tube obovoid, 1.4–2.5 × 1.3–2.5 mm, anthers 4, 6 or 7, (0.3–)0.5–0.8 × (0.3–)0.4–0.7 mm; ovary ovoid or subglobose, (0.3–)0.5–0.7 × (0.3–)0.6–1 mm, with dense stellate scales, locules 3, each with 2 ovules, stigma (0.2–)0.3–0.4 × 0.3–0.5 mm, with 3 lobes. Infructescences and fruits with numerous hairs or scales like that of the twigs. Infructescences to 15 cm long. Fruits with 3 longitudinal ridges running from base to apex, 3-locular, splitting into 3 lobes when ripe, 2–2.2 × 2.1–2.5 cm; pericarp c. 2 mm thick, pink or reddish purple, with white latex, when dry moulded around the seeds. Seeds subglobose, 1.5–1.6 × 1–1.1 × 0.8–0.85 cm, with an orange aril.

Vernacular names. Sabah—*langsats* (Dusun Kinabatangan). Sarawak—*segera* (Iban), *langsats* (Malay).

Distribution. Borneo and the Philippines (where it is only known from the type of *A. brachybotrys*). In Sabah, recorded from Keningau, Kinabatangan, Kuala Penyu, Kudat, Ranau, Sandakan, Tambunan and Tawau districts (e.g., *Beaman 7262*, *Pennington 7925*, *SAN 55805*, *SAN 81754* and *SAN 108188*) and in Sarawak from Kapit, Kuching, Miri and Mukah districts (e.g., *S 19320*, *S 23662*, *S 29169*, *S 30409* and *S 35292*). Also occurring in Brunei (e.g., *Coode 6440*) and Kalimantan (e.g., *Ambriansyah et al. AA 2070* and *Kostermans 21768*).

Ecology. In mixed dipterocarp and lower montane forests, on yellow clay soil and limestone, at altitudes to 1500 m.

Notes. Pannell (*op. cit.* 1992 & *op. cit.* 1995) treated *Aglaia beccarii* as a synonym of *Aglaia lawii*. However, the prominent pale green or orange venation on the lower leaflet surface, the orange-brown indumentum, the presence of stellate hairs, and the moulding of the pericarp around the seed in dry fruit, distinguish this species from *Aglaia lawii*. This is the only species of *Aglaia* native to Borneo that sometimes has leaves with a winged rachis.

4. *Aglaia bullata* Pannell

(Latin, *bullatus* = puckered; the leaflets)

Sect. *Aglaia*

Kew Bull. 59 (2004) 87. **Type:** *Ilias S 36269*, Borneo, Sarawak, Kapit district, Bt. Goram, right bank of Ulu Sg. Apah (holotype FHO; isotypes K, KEP, L, MO, SAR).

Tree to 10 m tall, to 12 cm diameter, branched. **Bark** smooth, greyish brown, latex white. **Twigs** slender, greyish brown, densely covered with reddish brown compact stellate hairs and scales. **Leaves** *imparipinnate*, 38–70 cm long; petioles 9–15 cm long; petioles, rachis and petiolules densely covered with hairs and scales like that of the twigs; *leaflets* with numerous pits on both surfaces, *upper surface with compact reddish brown stellate hairs occasionally interspersed with paler stellate scales, lower surface with numerous similar hairs and scales*; lateral leaflets 6–12 on each side of rachis, alternate to subopposite; *blades* *bullate, narrowly lanceolate*, $6.5\text{--}19 \times 1.2\text{--}3$ cm, base cuneate, margin wavy and recurved when dry, apex tapering to a long acute acumen to 15 mm long; midrib and lateral veins impressed above, prominent below; lateral veins 10–16 on each side of midrib, ascending, curved upwards and nearly or quite anastomosing near margin; intercostal venation impressed above, subprominent below; petiolules 0.1–0.5 cm long. **Flowers** unknown. **Infructescences** 15–20 cm long, 4–7 cm wide; peduncles to 11.5 cm long, densely covered with stellate hairs like that of the twigs. **Fruits** *indehiscent, 3-locular*, each locule containing 0 or 1 seed, subglobose, $1.3\text{--}1.5 \times 1.2\text{--}1.5$ cm; stalk 4–10 mm long; pericarp brownish yellow, densely covered with reddish brown compact stellate hairs.

Distribution. Endemic in Sarawak and known from Kapit and Mukah districts (e.g., *S* 36221, *S* 48582, *S* 79020 and the type).

Ecology. In mixed dipterocarp forest, on hillsides and ridges on yellow clay loam soil, at altitudes to 420 m.

5. *Aglaia coriacea* Korth. *ex* Miq.

(Latin, *coriaceus* = leathery; the leaflets)

Sect. *Aglaia*

Ann. Mus. Bot. Lugd. Bat. 4 (1868) 57; Merrill *op. cit.* (1921) 322; Masamune *op. cit.* 371; Pannell *op. cit.* (1989) 213, *op. cit.* (1992) 297, *op. cit.* (1995) 295; Whitmore, Tantra & Sutisna *op. cit.* 221; Turner *op. cit.* 336; Coode *et al.* (eds.) *op. cit.* 200. **Lectotype** (Pannell, 1992): *Korthals s.n.*, Borneo, Kalimantan, G. Bahay (U [Acc. No. 39257]; isoelectotype L [Acc. No. 9081321382]).

Small tree to 5 m tall, *usually unbranched with up to 10 leaves in a spiral at the apex, but occasionally with 1 or 2 branches in the upper part of the tree*. **Bark** brown with green and grey patches, with longitudinal and transverse cracks; inner bark dark pinkish red. **Sapwood** slightly paler than inner bark; heartwood pale pinkish red or yellowish brown. **Twigs** *densely covered with reddish brown stellate hairs with a dense cluster of short arms and a few long arms to 0.5 mm long at the apices*. **Leaves** *imparipinnate*, to 120 cm long; petioles to 35 cm long; leaflets coriaceous, *above dark glossy-green when dry, below paler and densely covered with reddish brown stellate hairs on the midrib and sometimes on the lateral veins*; lateral leaflets 3–7 on each side of rachis, subopposite, *basal ones only slightly smaller than the rest*; *blades* *oblong or obovate-oblong*, $13\text{--}43 \times 4\text{--}9$ cm, base cuneate or rounded, sometimes asymmetrical, margin recurved, apex acuminate, acumen obtuse or acute, to 25 mm long; midrib prominent or subprominent below; lateral veins 11–13 on each side of midrib, subprominent below; *intercostal venation inconspicuous*; petiolules 0.1–3.5 cm long. **Inflorescences** to 6 cm long and wide, axillary or sometimes on the upper part of stem below the lowest leaves, densely covered with reddish brown stellate hairs.

Flowers obovoid, *c.* 2.5 × 2 cm; *calyx* outside densely covered with reddish brown stellate hairs, *deeply divided into 5 obtuse lobes*; *petals* 5; staminal tube *c.* 2 mm tall, *anthers* 5, ovoid, *c.* 1 mm long; ovary small, depressed globose, stigma narrowly cylindrical, *c.* 0.6 mm across, with 2 small apical lobes. **Fruits** indehiscent, *locules* 1 or 2 (*rarely* 3), septa disintegrating at maturity, ellipsoid, 2.3–4 × 1.8–3.5 cm, yellow or brown; pericarp 0.5–1 mm thick, leathery, inner surface white. **Seeds** 2–3.5 × 1.5–2 cm, with inner surfaces flat; aril 0.5–1 mm thick, translucent, white, sweet and juicy.

Distribution. Peninsular Malaysia and Borneo. In Sabah and Sarawak rare, known only by one collection from Sabah (*Low s.n.*) and one from Sarawak (*S 16972*). Also occurring in Brunei (e.g., *Bernstein 366* and *Simpson 2550*) and C Kalimantan (e.g., *Korthals s.n.*, the type).

Ecology. In mixed dipterocarp forest, at altitudes to 270 m.

6. *Aglaia crassinervia* Kurz ex Hiern

Fig. 2.

(Latin, *crassus* = thick, *nervus* = nerve; the lateral veins on the leaflets)

Sect. *Aglaia*

In Hooker *f.*, Fl. Brit. Ind. 1 (1875) 556; Pannell *op. cit.* (1992) 213, *op. cit.* (1995) 267; Turner *op. cit.* 336; Coode *et al.* (eds.) *op. cit.* 200; Beaman & Anderson *op. cit.* 119. **Lectotype** (Pannell, 1992): *Helper 1609* (= *Kew Distr. 1038*), Myanmar, Tenasserim (K; isoelectotypes L, W). **Synonyms:** *Aglaia cinerea* King *op. cit.* (1895) 66, Ridley *op. cit.* (1922) 404; *Aglaia* sp., Merrill *op. cit.* (1929) 131; *Aglaia* sp. 6, Pannell *op. cit.* (1989) 229; *Aglaia* sp. 7/K, Whitmore, Tantra & Sutisna *op. cit.* 226.

Tree to 22 m tall, to 25 cm diameter, branched; flowering at about 5 m tall. **Bark** smooth, pale brown, yellowish brown, greyish brown or greyish green, lenticellate, sometimes with longitudinal cracks; inner bark pale yellow, pale orange, pale brown, reddish brown or pink; latex white. **Sapwood** yellow, white, pinkish brown or brown. **Twigs** fairly stout, *densely covered with yellowish brown or orange-brown or reddish brown, peltate scales with entire or fimbriate margin, less than 0.25 mm diameter*. **Leaves** imparipinnate, to 100 cm long; petioles to 20 cm long; leaflets often greyish green when dry, upper surface usually rugulose and with numerous pits, *lower surface usually pitted and covered with numerous scales like that of the twigs*; lateral leaflets (3–)5–7 on each side of rachis, alternate or subopposite, *terminal ones not folded at base*; *blades elliptical or occasionally ovate*, 7–35 × 4–12 cm, base rounded or cuneate, *slightly asymmetrical*, margin recurved, apex acuminate-caudate, acumen acute, to 15 mm long; midrib prominent below; lateral veins 9–17 on each side of midrib, subprominent below; intercostal venation faint on both surfaces; petiolules to 1.5 cm long. **Inflorescences** 30–50 cm long, to 60 cm wide, *densely covered with peltate scales similar to those on the twigs*. **Flowers** subglobose, 1.8–1.9 × 1.3–1.8 mm; *calyx* usually densely covered with scales like that of the twigs, *deeply divided into 5 rounded lobes*; *petals* 5; staminal tube subglobose, 1–1.3 × 1.1–1.3 mm, *anthers* 5, ovoid, 0.4–0.6 × 0.4–0.5 mm; ovary 0.1–0.5 × 0.4 mm, *locules* 1 (or 2), each containing 1 ovule, stigma ovoid or depressed globose with a central depression at the apex, 0.2–0.5 × 0.3–0.5 mm. **Fruits** indehiscent, *locules* 1 (or 2), each containing 1 seed, subglobose or pear-shaped, 2.5–3.5 × 2–2.5 cm, yellow or orange; pericarp woody or thin and brittle; stalk *c.* 1 cm long. **Seeds** *c.* 2 × 1.6 × 1.5 cm; aril *c.* 2 mm thick, translucent, green or reddish brown, slightly sour.

Vernacular names. Sabah—*balim* (Kadayan), *langsar-langsar* (Malay), *lantupak* (Dusun-Kinabatangan). Sarawak—*segera* (Iban), *sigirah* (Dyak), *kayu ta'an* (Murut).

Distribution. Nicobar Islands, Myanmar, Thailand, Sumatra, Peninsular Malaysia, Borneo and the Philippines. Common in Sabah and recorded from Keningau, Kinabatangan, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Tambunan and Tawau districts (e.g., *SAN 30435*, *SAN 40704*, *SAN 70949*, *SAN 88269* and *SAN 90918*) and in Sarawak from Kuching, Lawas, Lundu and Miri districts (e.g., *S 16006*, *S 26596*, *S 31555*, *S 39223* and *S 43995*). Also occurring in Brunei (e.g., *Kirkup DW 639*, *Kirkup DW 912* and *Prance 30694*) and Kalimantan (e.g., *Church et al. 1286*, *Endert 3149*, *Kostermans 8891* and *Lestari & Arifin HL 8*).

Ecology. In forest on sandy, sandy loam or clay soils, at altitudes to 750 m. The aril is eaten by monkeys.

7. *Aglaia cucullata* (Roxb.) Pellegr.

(Latin, *cucullatus* = hooded; the base of terminal leaflet)

Sect. *Amoora*

In Lecomte, Fl. Gén. Indo-Chine, 1 (1911) 771; Anderson *op. cit.* (1980) 250; Whitmore, Tantra & Sutisna *op. cit.* 221; Pannell *op. cit.* (1992) 58, *op. cit.* (1995) 213; PROSEA *op. cit.* (1995) 43; Turner *op. cit.* 336; Coode *et al.* (eds.) *op. cit.* 200; **Basionym:** *Amoora cucullata* Roxb. *op. cit.* (1820) 54, Miquel *op. cit.* (1868) 37, Hiern *op. cit.* 560, King *op. cit.* 55, Merrill *op. cit.* (1921) 321, Ridley *op. cit.* (1922) 399, Masamune *op. cit.* 373, Backer & Bakhuizen *f. op. cit.* 126. **Lectotype** (Pannell, 1992): Roxburgh '1238', India (BM). **Synonyms:** *Amoora aherniana* Merr., Philip. Gov. Lab. Bur. Bull. 17 (1904) 24; *Aglaia tripetala* Merr., J. Str. Br. Roy. As. Soc. 76 (1917) 88, *op. cit.* (1921) 323, Masamune *op. cit.* 373; *Aglaia conduplicifolia* Elmer, Leaflet. Philip. Bot. 9 (1937) 3324.

Tree to 20 m, to 35 cm diameter, branched. **Bark** pinkish grey or pale orange-brown, sometimes flaking in small brittle or papery scales; inner bark pink, fibrous; latex white. **Sapwood** pale yellowish brown, pink or orange-brown. **Twigs** slender, longitudinally wrinkled, *densely covered with pale brown or orange-brown peltate scales which are darker in the centre and have a paler, sometimes fimbriate, margin*. **Leaves** imparipinnate, to 45 cm long; petioles to 15 cm long; *leaflets subcoriaceous, lower surface rugulose and faintly pitted, with a few peltate scales on the midrib and lateral veins like that of the twigs and sometimes scattered on the surface in between; lateral leaflets 2 or 3 on each side of rachis, subopposite; blades ovate, 4–12.5 × 2.5–4.5 cm, that of terminal leaflets sometimes reduced in size to c. 4 × 1.5 cm and folded at the base forming a pocket on the upper surface, base rounded, markedly asymmetrical, margin slightly recurved, apex rounded; midrib impressed above, prominent below; lateral veins 8–13 on each side of midrib, subprominent and longitudinally wrinkled below, rarely black when dry; intercostal venation visible on both surfaces; petiolules to 4 cm long*. **Inflorescences** to 30 cm long, to 35 cm wide, *with a few to numerous scales like that of the twigs*. **Flowers:** males c. 2.2 × 2.2 mm; females c. 4.5 × 3.5 mm; *calyx divided almost halfway into 3 or 4 obtuse lobes, outside with a few to numerous white stellate scales; petals 3, c. 2–2.5 × 1.4–2.3 mm; staminal tube obovoid, c. 2 × 1.7 mm, anthers 6, c. 1.3 × 0.4 mm with a few simple white hairs; ovary 0.3–1 × 0.3–1.2 mm, locules 3, each containing 1 ovule, stigma ovoid, c. 0.3–0.7 × 0.5 mm*. **Fruits** *dehiscent, locules (2 or) 3, each containing 0 or 1 seed, obovoid, c. 9 × 6 cm, yellow; pericarp leathery, thin, brittle and moulded around the seeds when dry*. **Seeds** c. 5 × 3 cm, with a shiny, reddish brown aril.



Fig. 2. *Aglaia crassinervia*. A, leafy twig with male inflorescences; B, longitudinal section of male flower; C, twig with female inflorescence; D, longitudinal section of female flower; E, infructescence; F, peltate scale. (After Pannell, Kew. Bull. Add. Series 16 (1992) 215, f. 58; A–B from Pennington 7855, C–D from Mabberley 1703, E–F from Sangkachand 1602.)

Distribution. Bangladesh, Thailand, Vietnam, Sumatra, Peninsular Malaysia, Singapore, Borneo, the Philippines, Java and New Guinea. In Sabah, known from Kuala Penyu, Labuk Sugut, Sandakan and Sipitang districts (e.g., *BNB-FD 3042*, *SAN 34351*, *SAN 35479*, *SAN 35780* and *SAN 82466*) and in Sarawak from Bintulu, Lawas and Limbang districts (e.g., *Senada 2013*, *S 26792*, *S 33621*, *S 59069* and *S 59510*). Also occurring in Brunei (e.g., *BRUN 5077* and *BRUN 5125*) and Kalimantan (e.g., *Korthals s.n.* and *Kostermans 9550*).

Ecology. In riverine, tidal estuary, mangrove and nipah swamp and beach forests. Scarce to rather common, at altitudes to 20 m. The pouch at the base of the terminal leaflet is sometimes occupied by ants.

8. *Aglaia cumingiana* Turcz.

(Hugh Cuming, 1791–1865, English traveller, naturalist and plant collector)

Sect. *Aglaia*

Bull. Soc. Nat. Mosc. 31 (1858) 409; Masamune *op. cit.* 371; Pannell *op. cit.* (1992) 291, *op. cit.* (1995) 293; Coode *et al.* (eds.) *op. cit.* 200; Beaman & Anderson *op. cit.* 119. **Lectotype** (Pannell, 1992): *Cuming 1008*, the Philippines, Luzon, Prov. Albay (K; isoelectotypes BO, OXF, W). **Synonyms:** *Hearnia cumingiana* (Turcz.) C.DC. *op. cit.* (1878) 629; *Aglaia tarangisi* Elmer *op. cit.* 3314.

Tree to 15 m tall, to 15 cm diameter, branched. **Bark** greenish grey or greyish brown, hoop-marked, with pale lenticels in vertical rows; inner bark pale yellow to pinkish brown; latex white, copious. **Sapwood** white or pale yellow; heartwood reddish brown. **Twigs** greyish green, finely longitudinally wrinkled, with pale lenticels in vertical rows, *densely covered with small delicate pale brown stellate scales*. **Leaves** imparipinnate, 18–43 cm long; petioles 3–12 cm long; *leaflets* shiny dark green above, pale green below when fresh, *pale yellowish green or brownish green below and both surfaces matt when dry, covered with very few pale brown scales like that of the twigs on the midrib below*, often with numerous tiny shiny orange spots below; lateral leaflets 1–4 on each side of rachis, subopposite; *blades usually elliptical, 7–22 × 2–7.5 cm*, base asymmetrical, cuneate, sometimes rounded, margin slightly recurved, apex acuminate, acumen obtuse, to 15 mm long; midrib prominent below; *lateral veins 7–12 on each side of midrib, subprominent below, black or dark brown when dry; intercostal venation subprominent below*; petiolules 0.5–1 cm long. **Inflorescences** *delicate; peduncles, rachis and branches flat, covered with few pale brown stellate scales*; males 11–31 cm long, 11–28 cm wide; females *c.* 19 cm long, *c.* 10 cm wide; peduncles to 7 cm long. **Flowers** subglobose, *c.* 1 × 1–1.7 mm; *calyx divided into 5 subrotund lobes with fimbriate margins; petals 5*; staminal tube dark yellow, cup-shaped, 0.5–0.7 × 1–1.5 mm, *anthers 5*, 0.3–0.4 × 0.3–0.4 mm; ovary 0.1–0.2 × 0.2 mm, locules 2, each containing 1 ovule, stigma ovoid, 0.3–0.4 × 0.2–0.4 mm, with longitudinal ridges. **Fruits** *indehiscent, locules 2*, each containing 0 or 1 seed, ellipsoid, 0.9–1 × 0.9–1 cm, often asymmetrical when only one seed develops, and the stigma displaced to one side during development of the fruit, covered with few stellate scales like that of the twigs or without scales; pericarp orange-brown, papery thin and brittle when dry, orange or red when ripe and fresh.

Vernacular name. Sabah—*lantupak* (Dusun).

Distribution. Borneo and the Philippines. In Borneo, known only in Sabah from Beluran, Kota Belud, Kudat, Labuk Sugut, Lahad Datu, Ranau, Sandakan and Tenom districts (e.g., *SAN 23472*, *SAN 63245*, *SAN 86718*, *SAN 93597* and *SAN 118289*), in Sarawak from Kapit and Lundu districts (e.g., *S 4731*) and in Brunei (e.g., *Simpson 2150*).

Ecology. In primary, secondary and gallery forests, and along the seashore, on sandy soil and limestone, at altitudes to 1330 m.

9. *Aglaia densisquama* Pannell

Plate 1B.

(Latin, *densus* = dense, *squama* = scale; the dense indumentum on the leaflet lower surface)

Sect. *Aglaia*

Kew Bull. Add. Ser. 16 (1992) 133, *op. cit.* (1995) 240. **Type:** *Banyeng & Benang S 25209*, Borneo, Sarawak, Kuching district, Semengoh FR (holotype FHO; isotype L, SAR).

Tree to 20 m tall, to 35 cm diameter, branched. **Bark** smooth with longitudinal cracks; without latex. **Sapwood** pink, becoming darker towards the centre. **Twigs** grey, longitudinally wrinkled, *densely covered with dark reddish brown peltate scales 0.3–0.4 mm diameter with a pale margin*. **Leaves** imparipinnate, to 48 cm long; petioles 8–16 cm long; leaflets coriaceous, upper surface pale yellowish green when dry, rugulose and pitted, *midrib and lateral veins on the upper surface and the entire lower leaflet surface densely covered with scales like that of the twigs; lateral leaflets 4 or 5 on each side of rachis*, alternate or subopposite; *blades elliptical or ovate, 7–21 × 4–8 cm*, base rounded or cuneate, markedly asymmetrical, margin recurved, apex caudate-acuminate, acumen obtuse, to 20 mm long; midrib deeply impressed above, subprominent below; lateral veins 7–17 on each side of midrib, distinctly impressed above, subprominent below; intercostal venation faint or invisible on both surfaces; petiolules to 1.5 cm long. **Inflorescences** densely covered with scales like that of the twigs; males *c.* 42 cm long, *c.* 42 cm wide; females *c.* 28 cm long, *c.* 4 cm wide; peduncles 7–11 cm long. **Flowers** *c.* 3 × 3–4 mm; *calyx* thick and fleshy, *divided into 5 subrotund lobes; petals 5*, thick and fleshy, outside with scales like that of the twigs; staminal tube 1.5–1.7 × 2.2–2.5, *anthers 5*, 0.5–0.8 × 0.4–0.5 mm; ovary ovoid, *c.* 0.5–0.8 × 0.6–1 mm, locules 2, each containing 1 ovule, stigma ovoid, 0.2–0.3 × 0.3 mm. **Fruits** *indehiscent, locules 2*, each containing 1 seed, narrowly ellipsoid, ovoid or obovoid, 5–6 × 1.4–2 cm, *with a long narrow beak to 1.5 cm long and a short broad stalk to 5 mm long*. Aril entire, translucent, white.

Vernacular name. Sarawak—*segera* (Iban).

Distribution. Endemic in Borneo, known only in Sabah from Sandakan district (e.g., *SAN 54302* and *SAN 73613*) and in Sarawak from Bintulu, Kapit, Kuching and Limbang districts (e.g., *S 4389*, *S 27951*, *S 32523*, *S 36154*, *S 43962* and *S 46902*).

Ecology. In mixed dipterocarp, mossy lower montane and riverine forests, on alluvial sandy soils with some clay or on clayey loam, at altitudes to 1600 m.

10. *Aglaia edulis* (Roxb.) Wall.

(Latin, *edulis* = edible; the aril surrounding the seed)

Sect. Aglaia

Calc. Gard. Rep. (1840) 26; Hiern *op. cit.* 556; Pannell *op. cit.* (1992) 229, *op. cit.* (1995) 272; PROSEA *op. cit.* (1995) 44; Turner *op. cit.* 336; Beaman & Anderson *op. cit.* 120. **Basionym:** *Milnea edulis* Roxb., Hort. Beng. (1814) 18, *nom. nud.*, Fl. Ind., ed. Carey & Wallich 2 (1824) 430. **Lectotype** (Pannell, 1992): *Wall. Cat. 1279 C*, India, Silhet (K-W). **Synonyms:** *Aglaia acida* Koord. & Valetton, Meded 'S Lands Plant. 16 (1896) 143, Backer & Bakhuizen *f. op. cit.* 128; *Aglaia minahassae* Koord., Meded. 'S Lands Plant. 19 (1898) 382, 635; *Aglaia curranii* Merr., Philip. J. Sci., Bot. 7 (1912) 276; *Aglaia diffusa* Merr. *op. cit.* (1912) 277; *Aglaia samarensis* Merr. *op. cit.* (1916) 186; *Aglaia motleyana* Stapf, Bull. Misc. Inform. Kew (1930) 368, Whitmore, Tantra & Sutisna *op. cit.* (1990) 223.

Tree, 10–30 m tall, to 50 cm diameter, *branched*; buttresses to 1.75 m tall, to 50 cm out, to 15 cm thick. **Bark** pale brown, greyish brown, purplish brown, reddish brown or dark green; inner bark brown, reddish grey or yellow; latex white. **Sapwood** white, pink or yellow. **Twigs** greyish brown, longitudinally wrinkled, *densely covered with reddish brown, pale brown or orange-brown stellate hairs and scales or peltate scales with irregular or fimbriate margins*. **Leaves** *imparipinnate*, to 44 cm long; petioles 3.5–9 cm long; *leaflets often pale yellowish brown when dry, covered with few to numerous hairs or scales like that of the twigs on the midrib below and occasionally also on the rest of lower leaflet surface, sometimes with numerous reddish brown pits on both surfaces*; lateral leaflets 2–4 (or rarely 5) on each side of rachis, subopposite or alternate, *terminal ones not folded at the base, basal ones only slightly smaller than the rest*; blades usually elliptical, sometimes ovate or obovate, 5.5–25 × 4–11 cm, base slightly asymmetrical, rounded or cuneate, margin planar, apex acuminate, acumen obtuse, to 15 mm long; midrib prominent below; lateral veins 9–15 on each side of midrib, subprominent below, sometimes with shorter veins in between; *intercostal venation subprominent or faint but visible below*; petiolules 0.5–1.2(–2) cm long. **Inflorescences** axillary or occasionally borne on older branches, densely covered with hairs and scales like that of the twigs; males to 38 cm long, to 32 cm wide; females *c.* 5 cm long, *c.* 4 cm wide; peduncles 0.5–5 cm long. **Flowers** 1.4–1.8 × 1.4–2.6 mm; *calyx divided into 5 rounded lobes with ciliate margins*, outside with few to dense cover of scales like that of the twigs; *petals* 5; staminal tube 0.7–1.3 × 1.2–2.6 mm, *anthers* 5, ovoid, to 0.6 × 0.5 mm; ovary *c.* 0.4 × 0.3–0.7 mm, stigma depressed globose with a central depression or ovoid, 0.2–0.3 × 0.3–0.8 mm. **Fruits** *indehiscent*, *locules* 3, each containing 0 or 1 seed, *subglobose with an apical depression* or obovoid, 3.2–5 × 3.1–4.2 cm, with 3 longitudinal ridges running from base to apex, dull orange or brown or yellow when ripe; *pericarp* 3–6 mm thick, woody or granular, often with numerous warts, outside densely covered with small pale brown or nearly white peltate scales, inside rugulose, sometimes with white latex. **Seeds** pale brown, 14–20 × 10–19 × 5–9 mm; aril complete, sour, juicy, translucent, white or orange-brown, to 2 mm thick.

Vernacular names. Sabah—*lantupak* (Dusun-Kinabatangan). Sarawak—*segera* (Iban).

Distribution. India, Bhutan, Nicobar Islands, Myanmar, China, Vietnam, Cambodia, Thailand, Sumatra, Peninsular Malaysia, Java, Nusa Tenggara (Bali and Lombok), Borneo, the Philippines, Sulawesi and Maluku. In Borneo, recorded only in Sabah from Keningau, Kinabatangan, Labuk Sugut, Ranau, Sandakan, Tambunan and Tawau districts (e.g., *SAN* 33164, *SAN* 40701, *SAN* 77775, *SAN* 82938 and *SAN* 92160), in Sarawak from Bau, Kapit, Kuching, Miri and Song districts (e.g., *Haegens et al.* 420, *Mabberley* 1638, *S* 32672, *S* 65018 and *S* 76937) and in Kalimantan (e.g., *Burley et al.* 3138, *Endert* 2515, *Jarvie & Ruskandi* 6077, *Mahyar et al.* 3541 and *Sidiyasa PBU* 622).

Ecology. In forests on sandy soils, on banks of streams and ridge-tops, at altitudes to 700 m.

11. *Aglaia elaeagnoidea* (A.Juss.) Benth.

(Greek, *elaeagnoides* = resembling *Elaeagnus*, a genus of shrubs with indumentum comprising shiny scales)

Sect. *Aglaia*

Fl. Austral. 1 (1863) 383; Koorders & Valeton *op. cit.* (1913) t. 154; Backer & Bakhuizen *f. op. cit.* 128; Whitmore, Tantra & Sutisna *op. cit.* 221; Pannell *op. cit.* (1992) 143, *op. cit.* (1995) 243; PROSEA *op. cit.* (1995) 44; Turner *op. cit.* 336; **Basionym:** *Nemadra elaeagnoidea* A.Juss. *op. cit.* 239. **Lectotype** (Mabberley in Fl. Nouv.-Calédon. Dépend. 15 (1988) 75): *Baudin s.n.*, Australia (P; isoelectotypes BM, G, K). **Synonyms:** *Aglaia canariifolia* Koord. *op. cit.* 380, 633; *Aglaia parvifolia* Merr., Philip. Gov. Lab. Bur. Bull. 29 (1905) 21; *Aglaia elaeagnoidea* (A. Juss.) Benth. var. *pallens* Merr., Philip. J. Sci. 3 (1908) 413; *Aglaia pallens* (Merr.) Merr., Philip. J. Sci., Bot. 13 (1918) 297; *Aglaia cupreolepidota* Merr., Philip. J. Sci., Bot. 20 (1922) 393.

Small tree or shrub, 5–10(–20) m tall, 15–25 cm diameter, branched; sometimes with small buttresses. **Bark** brown, greyish brown or yellowish grey, with lenticels and narrow vertical fissures, flaking in thin, irregular, stiff scroll-like scales; inner bark pink or reddish brown. **Sapwood** yellow; heartwood red. **Twigs** slender, grey or pale brown, *densely covered with very pale brown or pale orange-brown peltate scales with entire or short-fimbriate margins and dark central spot*. **Leaves** imparipinnate, 6–29 cm long; petioles 2.5–10.5 cm long; leaflets subcoriaceous, reddish brown when dry, upper surface shiny, *lower surface densely covered with scales like that of the twigs on the midrib and sparsely so elsewhere*, with numerous faint or conspicuous pits on both surfaces; lateral leaflets 1–3 on each side of rachis, subopposite, *terminal ones not folded at the base*; *blades elliptical, sometimes obovate, 2–13(–16) × 1–6.5 cm, base cuneate, slightly asymmetrical, margin planar, apex rounded or acuminate, acumen obtuse, 2–5(–20) mm long; midrib prominent below; lateral veins 5–11 on each side of midrib, subprominent on both surfaces; intercostal venation subprominent on both surfaces; petiolules 0.5–2 cm long*. **Inflorescences** densely covered with peltate scales like that of the twigs or dark reddish brown in colour; males (3–)9–34 cm long, (1–)2.5–25 cm wide; females to 12.5 cm long and to 10 cm wide. **Flowers** subglobose or depressed globose, to 2 × 2 mm; *calyx shallowly divided into 5 broadly ovate obtuse lobes*, outside densely covered with scales like that of the twigs; *petals usually 5*, outside with scales; staminal tube depressed globose or ovoid, *c.* 1 × 1–1.4 mm, *anthers* 5, broadly ovoid, 0.4–0.5 × 0.3–0.4 mm; ovary subglobose, 0.2–0.3 × 0.5 mm, densely covered with stellate scales, locules 2, each containing 1 or 2 ovules, stigma ovoid with two small apical lobes, 0.2–0.3 × 0.3–0.4 mm. **Fruits** indehiscent, locules 2, each with 0 or 1 seed, *subglobose, ellipsoid or obovoid, 1.1–2.5 × 1.3–1.5 cm, orange, brown or red; pericarp thin, soft*. **Seeds** *c.* 10 × 6 × 3 mm, usually completely covered with a thin, white, gelatinous, sweet aril.

Vernacular name. Sabah—*lengud-lengud* (Dusun and Lumundau).

Distribution. India, Sri Lanka, Taiwan, Vietnam, Cambodia, Thailand, Sumatra, Peninsular Malaysia, Borneo, Java, Bali, Sulawesi, the Philippines, Maluku, New Guinea, Australia, Vanuatu, New Caledonia and Samoa. In Borneo, known only in Sabah from Lahad Datu, Sandakan and Tambunan districts and Sipadan Island (e.g., *Symington FD FMS 35357, SAN*

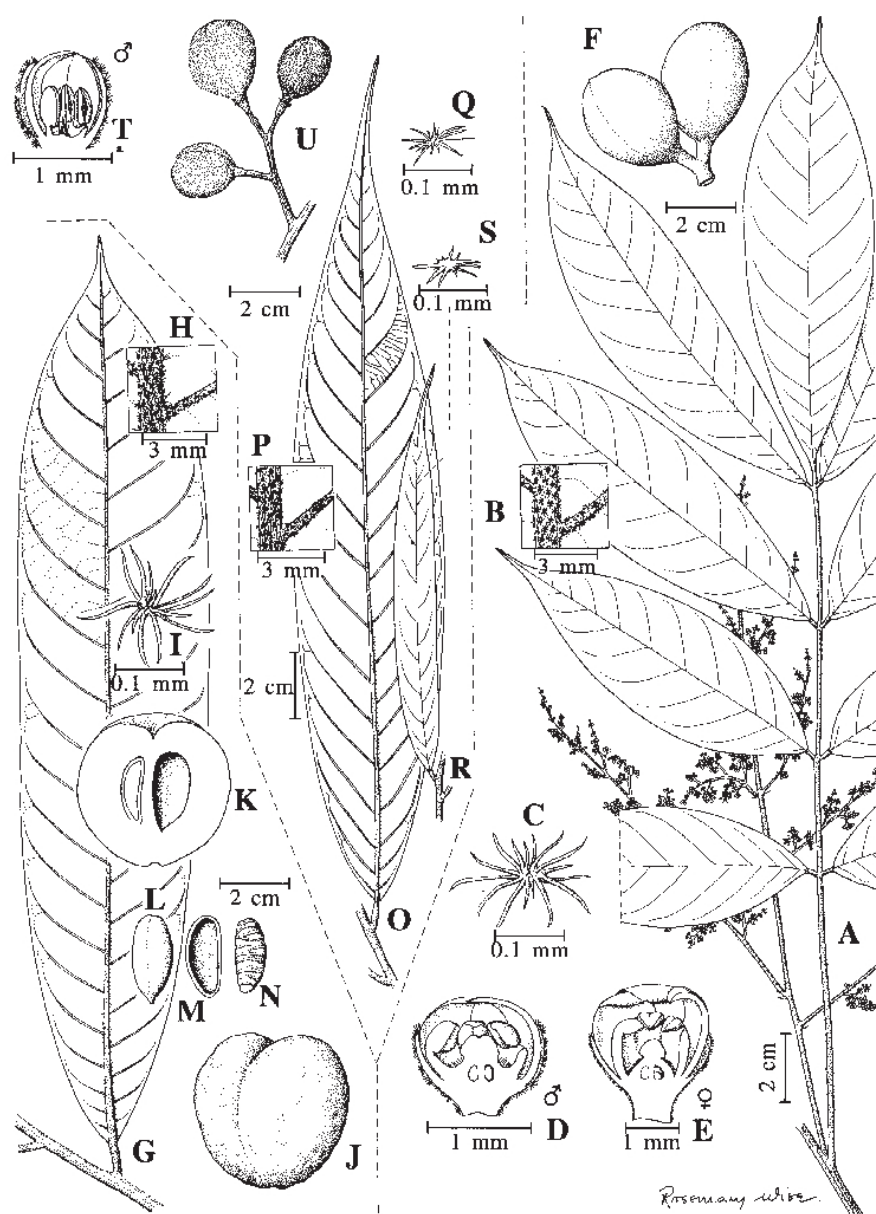


Fig. 3. *Aglaia elliptica*, subsp. *elliptica* (A–F), subsp. *clementis* (G–N); *A. lancifolia* (O–U). A, leafy twig with male inflorescence; B, detail of midrib and lateral vein on the lower leaflet surface showing indumentum; C, stellate hair; D, longitudinal section of male flower; E, longitudinal section of female flower; F, part of infructescence; G, leaflet; H, detail of midrib and lateral vein on the lower leaflet surface showing indumentum; I, stellate hair; J, fruit; K, inside of fruit showing the seeds; L, seed with aril; M, aril; N, seed without aril; O, large leaflet; P, detail of midrib and lateral vein on the lower leaflet surface showing indumentum; Q, stellate hair; R, small leaflet; S, stellate scale; T, longitudinal section of male flower; U, infructescence. (A–D from Pennington 7890, E from Pannell 1242, F from Pennington 8005, G–N from Pennington 7922, O–Q from Pennington 7998, R–S from SAN 78181, T from SAN 78297, U from S 27297.)

40497, SAN 122346 and Wong WKM 2479), in Sarawak from Miri district (e.g., S 16032 and S 31977) and in Kalimantan (e.g., Kessler PK 2283).

Ecology. Mainly found in coastal areas, including on rocky shores and sandy beach forest, sometimes inland including on limestone cliffs, at altitudes to 300 m.

12. *Aglaia elliptica* Blume

Fig. 3A–N.

(Latin, *ellipticus* = elliptical, widest in the middle and tapering at both ends; the shape of leaflets)

Sect. *Aglaia*

Bijdr. Fl. Ned. Ind. (1825) 171; Miquel *op. cit.* (1868) 50; Koorders & Valetton *op. cit.* (1913) t. 15; Backer & Bakhuizen *f. op. cit.* 126; Anderson *op. cit.* (1980) 248; Pannell *op. cit.* (1989) 214, *op. cit.* (1992) 275, *op. cit.* (1995) 288; Whitmore, Tantra & Sutisna *op. cit.* 221; PROSEA *op. cit.* (1995) 45; Turner *op. cit.* 336; Coode *et al.* (eds.) *op. cit.* 200; Beaman & Anderson *op. cit.* 120. **Lectotype** (here designated): Blume *s.n.* (1367), Java, Mt. Parang, Tjianjur (L [Acc. No. 908133141]). **Synonyms:** *Hearnia elliptica* (Blume) C.DC. *op. cit.* (1878) 628; *H. villosa* C.DC. *op. cit.* (1878) 632; ?*Aglaia harmsiana* J.Perkins, Notizbl. König Bot. Gart. & Mus. Berlin 32 (1903) 78; *Aglaia clementis* Merr. *op. cit.* (1918) 76; *Aglaia moultonii* Merr. *op. cit.* (1918) 78; *Aglaia villosa* (C.DC.) Merr. *op. cit.* (1921) 323; *Aglaia baramensis* Merr. *op. cit.* (1922) 317; *Aglaia havilandii* Ridl., Bull. Misc. Inform. Kew (1930) 367; *Aglaia tembelingensis* M.R. Henders., Gard. Bull. Str. Settl. 7 (1933) 94. (For further synonyms cf. Pannell *op. cit.* 1992 & *op. cit.* 1995.)

Tree, 20–40 m tall, to 50 cm diameter, *branched*; bole sometimes fluted throughout; L-shaped buttresses to 60 cm tall. **Bark** greenish brown, greyish green, grey, pale yellow or brown, smooth with shallow pits; inner bark reddish pink or green; latex white. **Sapwood** pale yellow or pale brown; heartwood deep pink. **Twigs** slender, grey, *densely covered with reddish brown, pale orange-brown or yellowish brown stellate hairs or scales, sometimes with pale brown or reddish brown peltate scales with fimbriate margins*. **Leaves** *imparipinnate*, 15–65 cm long; petioles 3–10 cm long; *leaflets dull when dry, lower surface densely covered with hairs or scales like that of the twigs on the midrib and sometimes on the lateral veins, sparsely so on the rest of that surface, not prominently pitted; lateral leaflets (rarely 2) 3–6 on each side of rachis, subopposite or almost alternate, basal ones only slightly smaller than the rest; blades elliptical or oblanceolate-oblong, or sometimes narrowly lanceolate, 5–25(–33) × 1–10.5 cm, base cuneate or rounded, asymmetrical, margin planar or recurved, often undulate, apex acuminate-caudate, acumen obtuse, 2–20 mm long; midrib prominent below; lateral veins 6–19 on each side of midrib, subprominent below; intercostal venation inconspicuous; petiolules 0.4–2.4 cm long*. **Inflorescences** densely covered with hairs or scales like that of the twigs; peduncles 1–10 cm long; males 23–50 cm long, 14–60 cm wide, bearing up to 6,000 flowers; females 13–37 cm long, 5–14 cm wide, bearing fewer flowers than males. **Flowers** depressed globose, 1–2.2 × 1–2.5 mm; *calyx deeply divided into 5 broadly ovate or elliptical, obtuse lobes, outside densely covered with brown stellate scales; petals usually 5; staminal tube shallowly cup-shaped, 0.2–0.6 × 1 mm, anthers 5, 0.3–0.5 × 0.3–0.4 mm; ovary subglobose, densely covered with stellate scales, locules 2, stigma ovoid or depressed globose, 0.2–0.3 × 0.1–0.3 mm, with two small apical lobes or a central depression*. **Fruits** *indehiscent, locules 1 or 2 (or 3), obovoid or ellipsoid, 1.5–3.4(–5) × 1.5–2.7(–4.8) cm, pink or orange when mature; pericarp 1–3(–12) mm thick, with a longitudinal ridge around it, along which the fruit opens under pressure*.

Seeds 1 or 2, to $2.8 \times 1.8 \times 1.1$ cm; aril 1–3 mm thick, sometimes not quite complete on the antiraphe side, pinkish orange, translucent, sweet or acidic tasting.

Vernacular names. Sabah—*lambunau* (Orang Sungei), *langsar gajah* (Malay), *langsar-langsar* (Malay), *langsar munyit* (Malay), *lantupak* (Dusun Kinabatangan), *lantupak jambu* (preferred name). Sarawak—*bunyak* (Iban), *bunyau* (Punan), *buyau* (Punan), *segera* (Iban), *segera ayer* (Iban).

Distribution. Myanmar, Thailand, Sumatra, Peninsular Malaysia, Borneo, Java, Nusa Tenggara (Bali and Flores), Sulawesi and the Philippines.

Uses. In various parts of its range, the wood is used for furniture, general construction and agricultural implements. Bathing in water boiled with the bark is used against tumours, whereas leaves are applied to wounds.

Notes. In Sabah and Sarawak, two subspecies are recognised, viz. subsp. *elliptica* and subsp. *clementis*. *Aglaia lancifolia*, previously treated as a synonym of this species by Pannell (*op. cit.* 1992 & *op. cit.* 1995), is now recognised as a distinct species, endemic in Borneo.

Key to subspecies

Fruits to 3.4×2.7 cm when ripe; pericarp c. 3 mm thick.....

subsp. **elliptica** Fig. 3A–F.

Synonyms: *Hearnia elliptica* (Blume) C.DC. *op. cit.* (1878) 628; *H. villosa* C.DC. *op. cit.* (1878) 632, Merrill *op. cit.* (1921) 323, Masamune *op. cit.* 373, Anderson *op. cit.* (1980) 249, Whitmore, Tantra & Sutisna *op. cit.* 225; ?*Aglaia harmsiana* J.Perkins *op. cit.* 78, Anderson *op. cit.* (1980) 248, Whitmore, Tantra & Sutisna *op. cit.* 222, Beaman & Anderson *op. cit.* 120; ?*Aglaia moultonii* Merr. *op. cit.* (1918) 78, *op. cit.* (1921) 322, Masamune *op. cit.* 372; *Aglaia villosa* (C.DC.) Merr. *op. cit.* (1921) 323; *Aglaia baramensis* Merr. *op. cit.* (1922) 317; *Aglaia havilandii* Ridl. *op. cit.* (1930) 367, Anderson *op. cit.* (1980) 248. (For further synonyms, cf. Pannell *op. cit.* 1992 & *op. cit.* 1995.)

Lateral leaflets (2 or) 3–6 on each side of rachis; *blades elliptical or oblanceolate-oblong*, $5-25(-33) \times 1.5-10.5$ cm, less than 5 times longer than wide. Fruits $1.5-3.4 \times 1.5-2.7$ cm; pericarp c. 3 mm thick.

Distribution as the species. Common in Sabah and Sarawak; in Sabah, recorded from Keningau, Kinabatangan, Labuk Sugut, Lahat Datu, Ranau, Sandakan, Semporna, Sipitang, Tawau and Tenom districts (e.g., *SAN 24024*, *SAN 30004*, *SAN 41639*, *SAN 64310* and *SAN 83280*) and in Sarawak from Belaga, Bintulu, Kapit, Lawas, Lubok Antu, Lundu, Marudi, Miri, Serian, Simunjan and Tatau districts (e.g., *S 33257*, *S 36761*, *S 37885*, *S 40642* and *S 44648*). Also occurring in Kalimantan (e.g., *Burley et al.* 2497, *Church et al.* 504, *Church et al.* 5497, *Kessler B1428* and *Mahyar et al.* 1328) but not yet recorded from Brunei.

Common in riverine forest and periodically flooded lowland and hill forest, at altitudes to 1500 m, on igneous-derived, sandy, clay, loam, and basalt-derived soils. Sometimes rooting below the flood level.

Fruits to 5×4.8 cm when ripe; pericarp to 1.2 cm thick, otherwise indistinguishable from subsp. *elliptica*.....

subsp. **clementis** (Merr.) Pannell

Fig. 3G–N.

(Mary S. Clemens, died in 1968, prolific plant collector in Borneo, Papua New Guinea and the Philippines)

Kew Bull. 59 (2004) 89. Basionym: *Aglaia clementis* Merr. *op. cit.* (1918) 76, *op. cit.* (1921) 322, Masamune *op. cit.* 372, Beaman & Anderson *op. cit.* 120. Lectotype (Pannell, 1992): *M.S. Clemens 10484*, Borneo, Sabah, Mt. Kinabalu, Minitindok Gorge (PNH†; isoelectotypes A, BM, UC).

Leaflets to 40×18 cm, either coriaceous and recurved at the margin, or like the typical subspecies, sometimes with numerous reddish brown pits on the lower surface. *Fruits* to 5×4.8 cm, obovoid with an apical depression and longitudinal depressions between the seeds; locules 2 (or 3); *pericarp* to 1.2 cm thick. Seeds 2.

Borneo and Sulawesi. In Sabah, known from Kota Belud, Lahad Datu, Ranau, Sandakan and Tawau districts (e.g., *SAN 18822*, *SAN 24752*, *SAN 30651*, *SAN 59235* and *SAN 85098*) and in Sarawak from Bau, Simunjan and Serian districts (e.g., *S 28095*, *S 30853*, *S 37550*, *S 45286* and *S 45599*). Also known from Kalimantan (e.g., *Argent et al. 93160* and *Zainal & Arbainsyah AA 1794*) but not yet recorded from Brunei.

In lowland forests, including on limestone, on well-drained sandy soil, at altitudes to 250 m.

13. *Aglaia erythrosperma* Pannell

Fig. 4A–D.

(Greek, *erythros* = red, *sperma* = seed; the seed is completely covered with a red aril)

Sect. *Amoora*

Kew Bull. Add. Ser. 16 (1992) 76, *op. cit.* (1995) 219, PROSEA *op. cit.* (1995) 45; Turner *op. cit.* 336. **Type:** *Pannell 1175*, Peninsular Malaysia, Negri Sembilan, Pasoh FR (holotype FHO). **Synonyms:** *Aglaia* sp. 2, Pannell *op. cit.* (1989) 228; *Aglaia* sp. 2/B, Whitmore, Tantra & Sutisna *op. cit.* 226.

Tree to 20 m tall, to 30 cm diameter, branched; L-shaped buttresses to 70 cm out. **Bark** pale yellow or white, smooth, slightly flaky; inner bark pinkish brown, red or green; latex white. **Sapwood** pink or pinkish brown, with watery greenish brown exudate. **Twigs** stout, *densely covered with brown stellate scales*. **Leaves** *imparipinnate*, to 60 cm long; petioles to 25 cm long; *leaflets* coriaceous, *surface smooth or slightly rugulose, greenish brown, upper surface shiny, lower surface dull, covered with few to numerous pale brown stellate scales like that of the twigs on the midrib and lateral veins and sparsely so on the surface in between; lateral leaflets 3–5 on each side of rachis*, opposite, subopposite, or sometimes alternate; *blades elliptical, 7–18 × 4.5–7.5 cm* (that of immature plant to 40×12 cm), *base rounded, sometimes cuneate*, asymmetrical, *margin slightly recurved*, apex short-acuminate, acumen acute, to 5 mm long; midrib raised and longitudinally ridged and wavy below; *lateral veins 9–14 on each side of midrib*, raised and longitudinally ridged below, *of the same colour as the rest of leaflet; intercostal venation inconspicuous*; petiolules 2–3 cm long. **Inflorescences** to 20 cm long, densely covered with stellate scales like that of the twigs. **Flowers** *c.* $5.5 \times 4–5$ mm; *calyx divided up to halfway into 3 broad, obtuse lobes*, outside densely covered with stellate scales; *corolla* $4.3–5 \times 4$ mm, *divided almost to the base into 3 lobes*, outside covered with a few to dense pale orange-brown stellate scales; staminal tube obovoid, $4–4.2 \times 2.8–3.4$ mm, *anthers* 7, ellipsoid, $2–2.1 \times 0.5–0.7$ mm;

ovary depressed globose with 3 lobes, *c.* 0.3 × 1.1 mm, densely covered with stellate scales, locules 3, each containing 1 ovule, stigma ovoid, 0.6–0.8 × 0.7–1 mm, with 6 longitudinal lobes. **Fruits** *subglobose*, to 10 cm diameter, deep reddish brown, outside densely covered with reddish brown stellate hairs, *locules* 3, each containing 1 seed, *dehiscing into 3 lobes when ripe*; *pericarp to 1.5 cm thick*, inner pericarp white, innermost layer in each locule a detachable membrane surrounding the seed. **Seeds** to 5 × 3.5 × 2 cm, completely surrounded by a bright shiny orange-red aril, which is easily detached from the rest of the seed; testa shiny chestnut-brown.

Vernacular names. Sarawak—*bunya* (Iban), *segera* (Iban).

Distribution. Thailand, Sumatra, Peninsular Malaysia and Borneo. In Sabah, recorded from Sipitang district (e.g., *SAN 16752*) and in Sarawak from Bintulu, Kuching and Miri districts (e.g., *S 2253*, *S 18067*, *S 37168*, *S 38973* and *S 39120*). Also occurring in Kalimantan (e.g., *Kostermans 6116* and *Kostermans 9557*) but not yet recorded from Brunei.

Ecology. In mixed dipterocarp and *kerangas* forests, at altitudes to 400 m. The Black Hornbill, *Anthracoceros malayanus*, feeds on the seeds and regurgitates them with the aril removed.

14. *Aglaia exstipulata* (Griff.) W.Theob.

(Latin, *exstipulatus* = without stipules; originally placed in the Sapindaceae where most species have stipules)

Sect. *Aglaia*

In F. Mason, *Burmah* 3rd edition, 2 (1883) 583; Pannell *op. cit.* (1989) 215, *op. cit.* (1992) 320, *op. cit.* (1995) 303; Whitmore, Tantra & Sutisna *op. cit.* 222; PROSEA *op. cit.* (1995) 45; Turner *op. cit.* 336; Coode *et al.* (eds.) *op. cit.* 201; Beaman & Anderson *op. cit.* 120. **Basionym:** *Euphoria* ('*Euphora*') *exstipulata* ('*exstipulatis*') Griff., Not. Pl. As. 4 (1854) 547. **Lectotype** (Pannell, 1992): Griffith 985 (= *Kew Distr. 1040*), Myanmar, Mergui (K). **Synonyms:** *Aglaia minutiflora* Bedd. var. *griffithii* Hiern *op. cit.* 557; *Aglaia griffithii* (Hiern) Kurz, J. As. Soc. Beng. 44 (1875) 146, King *op. cit.* 75, Ridley *op. cit.* (1922) 409, Anderson *op. cit.* (1980) 248.

Distribution. Myanmar, Thailand, Vietnam, Peninsular Malaysia, Singapore and Borneo.

Notes. Two subspecies are recognised, viz. subsp. *exstipulata* and subsp. *brunneostellata*. The former does not occur in Borneo; the latter is endemic in Borneo and differs from the former in its fewer leaflets which have a smaller length/breadth ratio and are covered with compact stellate hairs distributed evenly on the lower surface so that they are visible to the naked eye as brown dots.

subsp. **brunneostellata** Pannell

(Latin, *brunneus* = brown, *stellatus* = stellate; the indumentum)

Kew Bull. 59 (2004) 89; Beaman & Anderson *op. cit.* 120. **Type:** *E. Wright S 23972*, Borneo, Sarawak, Kapit district, Bt. Raya (holotype FHO; isotypes KEP, SAN, SAR).

Tree to 15 m tall, to 22 cm diameter, branched. **Bark** smooth, brownish yellow or greyish brown; inner bark pale yellowish brown; latex white. **Sapwood** pale yellowish brown. **Twigs** slender, brown, *densely covered with reddish brown stellate hairs*. **Leaves** *imparipinnate*, to 60 cm long; petioles to 11 cm long; *leaflets without or with numerous pits on both surfaces*, upper surface with hairs like that of the twigs on the impressed midrib, *lower surface densely covered with reddish brown stellate hairs (with arms of adjacent hairs not overlapping) on the midrib, numerous on the rest of the surface, interspersed with smaller,*

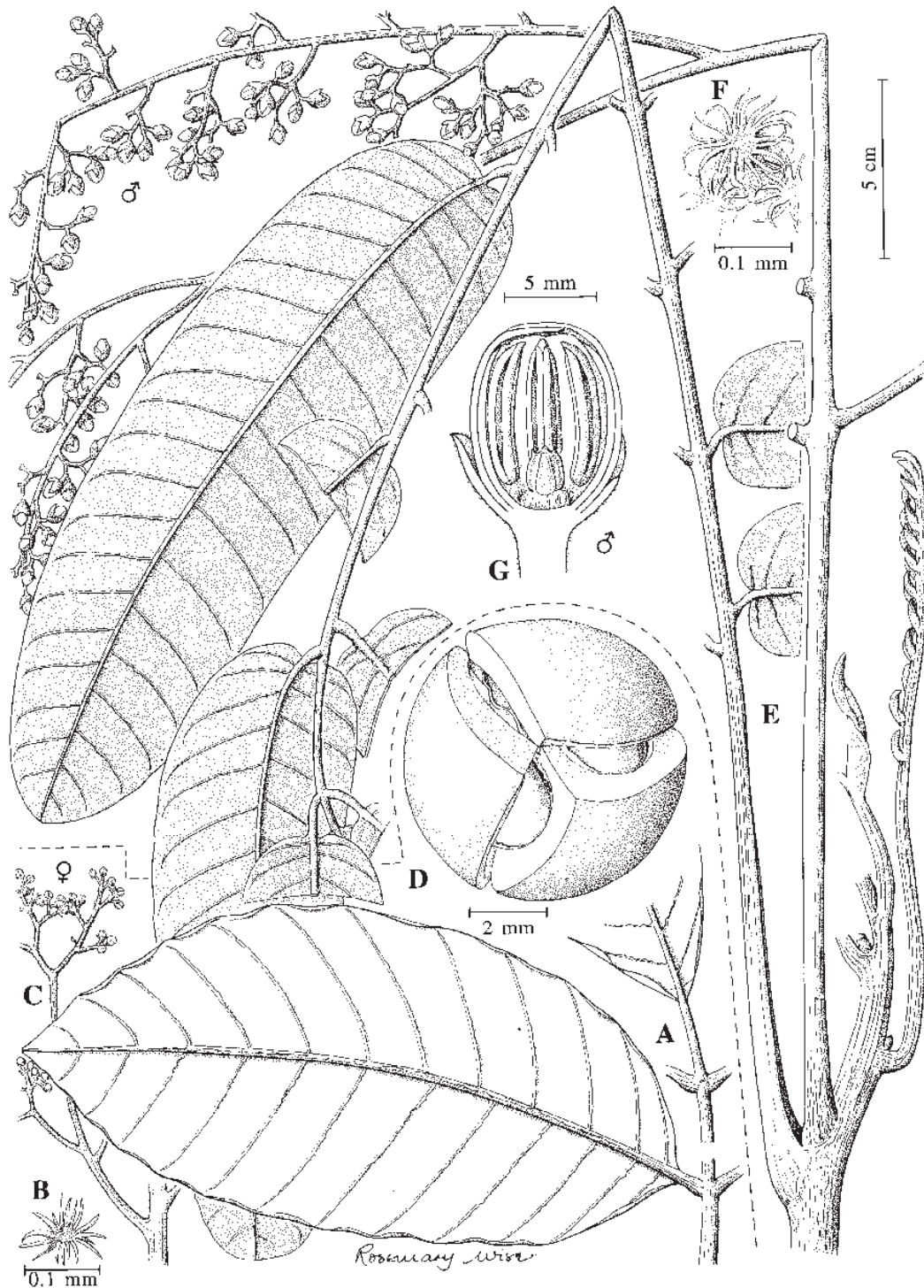


Fig. 4. *Aglaia erythrosperma* (A–D); *A. rubiginosa* (E–G). A, leaf apex and leaflet; B, stellate scale; C, part of female inflorescence; D, fruit; E, leafy twig with male inflorescence; F, stellate scales; G, longitudinal section of male flower. (After Pannell, TFM 4 (1989) 224, f. 3; A–D from Pannell 1175, E–F from KEP 74115, G from SFN 27277.)

paler reddish brown or orange-brown, fewer-rayed stellate hairs; lateral leaflets 3–5 on each side of rachis, subopposite; blades oblong or narrowly elliptical, 4.5–10.5 × 2.5–6 cm, base rounded or cuneate, asymmetrical, margin slightly wavy, apex acuminate or caudate, acumen acute or obtuse, to 15 mm long; midrib impressed above, prominent below; lateral veins 7–12 on each side of midrib, impressed above, subprominent below; intercostal venation prominent below; petiolules 1–2 cm long. Inflorescences densely covered with reddish brown stellate hairs like that of on the twigs; males to 40 cm long and wide; females smaller and less-branched. **Flowers** *c.* 0.9 × 0.8 mm (males) or *c.* 2 × 1.7 mm (females); *calyx divided almost to the base into 5 rotund, obtuse lobes*, outside with numerous to densely covered with reddish brown stellate hairs; *petals 5*; staminal tube 0.4–0.9 × 0.7 mm, anthers 5, 0.2–0.3 × 0.2 mm; ovary depressed globose, 0.1–0.2 × 0.3–0.6 mm, stigma depressed globose, 0.1–0.2 × 0.2–0.3 mm. **Fruits indehiscent, locules 2**, each containing 1 seed, subglobose, 1.2–1.7 × 0.8–1.7 cm, densely hairy. **Seeds** surrounded by a white edible aril.

Distribution. Borneo and the Philippines (Palawan, known from one collection, *Stone et al.* 282). In Sabah, known from Kota Merudu, Labuk Sugut, Lahad Datu, Ranau, Tambunan and Tenom districts (e.g., *Pennington* 7940, *SAN* 67586, *SAN* 85025, *SAN* 118919 and *SAN* 133699) and in Sarawak from Bau, Kapit, Limbang, Lundu and Marudi districts (e.g., *S* 35481, *S* 36392, *S* 46376, *S* 47696, *S* 47845 and *S* 74113). Also occurring in Brunei (e.g., *Wong WKM* 1529) and Kalimantan (e.g., *Burley et al.* 2400, *Church et al.* 759, *Church et al.* 796, *Mahyar* 3099 and *Tuke* P9 469).

Ecology. In mixed dipterocarp and *kerangas* forests on sandy clay soil, at altitudes to 740 m.

15. *Aglaia forbesii* King

Plate 2C.

(Henry Ogg Forbes, 1851–1932, Scottish botanist and ethnologist)

Sect. *Aglaia*

J. As. Soc. Beng. 64, 1 (1895) 68; Ridley *op. cit.* (1922) 406; Anderson *op. cit.* (1980) 248; Pannell *op. cit.* (1989) 215, *op. cit.* (1992) 207, *op. cit.* (1995) 265; Whitmore, Tantra & Sutasna *op. cit.* 222; PROSEA *op. cit.* (1995) 46 Turner *op. cit.* 337; Coode *et al.* (eds.) *op. cit.* 201. **Syntypes:** *King's collectors* 10787, Peninsular Malaysia, Perak, Ulu Kali (BM, G, K, L); *King's collector* 4762, Peninsular Malaysia, Perak, Larut (BM, CGE, G); *Curtis* 1631, Perak, Pangkor, Sg. Bruas (SING); *Wray Jr.* 3265, Perak, Larut (SING); *Forbes* 3179, Sumatra, Mt. Napalhitju (BM, K, L). **Synonym:** *Aglaia humilis* King *op. cit.* 69, Ridley *op. cit.* (1922) 407, Pannell *op. cit.* (1989) 218.

Tree to 20 m tall, to 20 cm diameter, *branched*; buttresses (if present) to 1.2 m high. **Bark** brown, pale brown, greenish grey or yellow; inner bark brown, greyish brown, orange-brown or reddish brown; latex white. **Sapwood** pale yellow, pale brown or pale pink. **Twigs** slender, greenish brown or brown, smooth or longitudinally wavy ridged, *densely covered with dark brown, reddish brown or greyish brown stellate scales or hairs*. **Leaves** *imparipinnate, to 100 cm long; petioles to 35 cm long; leaflets* subcoriaceous to coriaceous,

blackish green when dry, both surfaces prominently pitted, lower surface with a few to numerous reddish brown or greyish brown stellate hairs (with arms of adjacent hairs overlapping; hairs without central rachis) or scales on the midrib, lateral veins and occasionally on the surface in between; lateral leaflets 5–6(–9) on each side of rachis, alternate or sometimes subopposite, basal ones only slightly smaller than the rest; blades elliptical, oblong or ovate, $8.5\text{--}21 \times 3.5\text{--}9$ cm, base rounded or cuneate, asymmetrical, margin strongly recurved, apex acuminate, acumen acute or cuneate, to 12 mm long; midrib slightly impressed above, prominent below, often almost black when dry; lateral veins 12–24 on each side of midrib, slightly impressed above, subprominent below, nearly black when dry; intercostal venation barely visible; petiolules 1.5–2 cm long. **Inflorescences** to 35 cm long and 25 cm wide, densely covered with pale brown or reddish brown stellate scales or hairs. **Flowers** $1.5\text{--}3 \times 1.5\text{--}2.5$ mm; calyx lobes 5 or rarely 6, outside densely covered with stellate scales or hairs; petals 5 or rarely 6; staminal tube obovoid, $1\text{--}2.2 \times 1\text{--}1.8$ mm, anthers 5, $0.6\text{--}0.8 \times 0.3\text{--}0.5$ mm; ovary subglobose, $0.2\text{--}0.6 \times 0.3\text{--}1.2$ mm, locules 2, each with 1 ovule, stigma ovoid, $0.2\text{--}0.6 \times 0.2\text{--}0.5$ mm, black and shiny, with two small apical lobes. **Fruits** indehiscent, locules 2, each containing 0 or 1 seed, ellipsoid or subglobose, to 4×3.8 cm, sometimes with a small beak at the apex and sometimes narrowed at the base into a short stalk to 4 mm long, sometimes with a longitudinal ridge around it; pericarp to 4 mm thick, soft, fibrous and flexible, white, yellow, orange, grey or greenish grey, sometimes longitudinally wrinkled when dry, outside densely covered with white or yellowish grey stellate scales or peltate scales with fimbriate margins, inside shiny, with white latex. **Seeds** $1.5\text{--}3 \times 2\text{--}2.2 \times 1.5$ cm; aril completely covering the seed, translucent, gelatinous, yellow or pink, to 3 mm thick, sweet-sour or with a flavour like that of langsat.

Vernacular names. Sabah—*langsat burung* (Malay), *lantupak* (Dusun Kinabatangan). Sarawak—*segera* (Iban), *suloh* (Selakau/Melanau).

Distribution. Myanmar, Thailand, Sumatra, Peninsular Malaysia and Borneo. In Sabah, recorded from Keningau, Kinabatangan, Labuk Sugut, Sandakan, Sipitang and Tenom districts (e.g., SAN 13266, SAN 26893, SAN 73181, SAN 97645 and SAN 132941) and in Sarawak from Belaga, Kapit, Kuching, Lawas and Limbang districts (e.g., Mabberley 1617, S 12288, S 27909, S 38741 and S 47590). Also known from Brunei (e.g., Dransfield JD 7264 and KEP 30405) and Kalimantan (e.g., Church *et al.* 1364, Kessler *et al.* B 336, Mabberley 1598, Wilkie 9514 and Wilkie 93343).

Ecology. In forest along rivers, on sandy, clay or sandy loam soils, at altitudes to 950 m.

16. *Aglaia foveolata* Pannell

(Latin, *foveolatus* = minutely pitted; the leaflet surfaces)

Sect. *Aglaia*

Kew Bull. Add. Ser. 16 (1992) 211, *op. cit.* (1995) 266; PROSEA *op. cit.* (1995) 46. Turner *op. cit.* 337; Coode *et al.* (eds.) 201. **Type:** *Kochummen FRI 2112*, Peninsular Malaysia, Terengganu, Jerangau FR (holotype K; isotype KEP). **Synonyms:** *Aglaia* sp. 7, Pannell *op. cit.* (1989) 230; *Aglaia* sp. 8/L, Whitmore, Tantra & Sutisna *op. cit.* 226.

Tree, 20–25 m tall, to 70 cm diameter, *branched*; buttresses to 75 cm tall, to 30 cm out. **Bark** smooth, reddish brown or greyish brown, with shallow longitudinal fissures; inner

bark pale brown or reddish brown; latex white. **Sapwood** yellowish brown; heartwood brown or reddish brown. **Twigs** slender, *densely covered with reddish brown stellate hairs or scales near the apex*. **Leaves** imparipinnate, to 42 cm long; petioles to 8 cm long; leaflets yellowish green or brown when dry, with numerous pits on both surfaces, upper surface usually dull, lower surface rugulose; scales or hairs like that of twigs few or dense on the midrib on both surfaces and absent to numerous on the rest of the lower surface; lateral leaflets (5–)6–8(–13) on each side of rachis, subopposite, basal ones only slightly smaller than the rest; blades elliptical, oblong or lanceolate, 5–13.5 × 1.3–4.5 cm, base asymmetrical, cuneate or rounded, margin recurved, apex acuminate-caudate, acumen obtuse, to 15 mm long; midrib prominent below; lateral veins 9–15(–24) on each side of midrib, sometimes with shorter veins in between, subprominent below; intercostal venation sometimes subprominent or faint but visible below; petiolules to 0.8 cm long. **Inflorescences** densely covered with reddish brown indumentum like that on the twigs, to 22 cm long and wide. **Flowers** c. 2 × 1.5–2 mm; calyx deeply divided into 5 ovate, obtuse lobes, outside with a few to dense cover of stellate hairs or scales; petals 5; staminal tube 1–1.5 × 1–1.5 mm, anthers 5, ellipsoid, 0.6–0.8 × 0.4 mm; ovary subglobose or depressed globose, c. 0.4 × 0.9 mm, stigma narrowly ovoid or ellipsoid with longitudinal ridges, subglobose or with two lobes at apex, c. 0.5–0.3 mm. **Fruits** indehiscent, locules 1 or rarely 2, each containing 1 seed, subglobose or broadly ellipsoid, to 2.5 cm long, purple, brown, orange or yellow, densely covered with stellate hairs or scales. Aril translucent, sweet.

Vernacular name. Sarawak—*segera* (Iban).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah, known from Labuk Sugut and Sandakan districts (e.g., *SAN* 27188, *SAN* 50688, *SAN* 82053, *SAN* 83601 and *SAN* 92188) and in Sarawak from Bintulu, Kapit, Kuching, and Limbang districts (e.g., *S* 13955, *S* 25483, *S* 27979, *S* 36448 and *S* 43200). Also occurring in Brunei (e.g., *Araffin* *ARK* 103, *BRUN* 658 and *Wong* *WKM* 350) and Kalimantan (e.g., *Jarvie & Ruskandi* 5406, *Jarvie & Ruskandi* 5922, *Jarvie & Ruskandi* 6921 and *Sidiyasa* 1422).

Ecology. In swamp, riverine and ridge forests, on sandy, silty clay and clay soils, at altitudes to 1000 m.

17. *Aglaia glabrata* Teijsm. & Binn.

Plate 2D.

(Latin, *glabratus* = nearly without hairs or scales; the leaflets)

Sect. *Aglaia*

Nat. Tijdschr. Ned. Ind. 27 (1864) 42; Miquel *op. cit.* (1868) 58; Pannell *op. cit.* (1992) 177, *op. cit.* (1995) 254; Turner *op. cit.* 337. **Type:** *Cult. Hort. Bogor III-B-60*, origin Sumatra, Bangka; vernacular name *bawang* (holotype BO). **Synonym:** *Aglaia chaudiocensis* auct. non Pierre (1896): Anderson *op. cit.* (1980) 247.

Tree to 20 m tall, to 30 cm diameter, *branched*; buttresses steep to 1.2 m high. **Bark** greyish brown or greenish brown; inner bark pale yellow; latex white. **Sapwood** yellowish. **Twigs** *densely covered with dark purplish brown peltate fimbriate scales or with reddish brown or orange-brown stellate scales of less than 0.2 mm diameter*. **Leaves** imparipinnate, to 22 cm long; petioles 3.5–7 cm long; *when dry, leaflets dull and often green above and brown below, both surfaces usually with numerous prominent pits, lower surface without hairs or scales except for the midrib which is densely covered with scales like that of the twigs*;

lateral leaflets 2–4 on each side of rachis, subopposite or sometimes alternate, *basal ones only slightly smaller than the rest*; *blades elliptical or rarely ovate*, $4\text{--}10\text{--}(13) \times 1.5\text{--}4\text{--}(5)$ cm, base cuneate, slightly asymmetrical, margin planar, apex acuminate with obtuse acumen; midrib prominent below; lateral veins 6–13 on each side of midrib, subprominent below; *intercostal venation faint but visible on both surfaces*; *petiolules to 0.7 cm long*. **Inflorescences** to 12 cm long and wide, densely covered with peltate scales like that of the twigs or with stellate scales on the peduncles, rachis and branches. **Flowers** subglobose, $1\text{--}1.5 \times 1\text{--}1.5$ mm; *calyx shallowly divided into 5 obtuse lobes*, outside densely covered with scales like that of the rest of the inflorescence; *petals 5*; staminal tube obovoid, $c. 1 \times 1$ mm, anthers 5, ovoid, $0.5\text{--}0.7 \times 0.3\text{--}0.5$ mm; ovary subglobose, $0.3\text{--}0.5 \times 0.3\text{--}0.5$ mm, densely covered with reddish brown stellate hairs or scales, locules 2, stigma ovoid with two apical lobes, $0.2\text{--}0.5 \times 0.2\text{--}0.5$ mm. **Fruits** indehiscent, *locules 1 or 2*, subglobose, $c. 1.5 \times 1.4$ cm, either densely covered with scales like that of the twigs or with orange-brown peltate fimbriate scales.

Vernacular name. Sarawak—*segera* (Iban).

Distribution. Sumatra, Peninsular Malaysia, Borneo and Maluku. In Sabah, known from Beaufort, Keningau, Kinabatangan, Papar, Sandakan and Sipitang districts (e.g., *Jeprin & Sidkan MB 993*, *SAN 80347*, *SAN 86271*, *SAN 103628* and *SAN 126701*) and in Sarawak from Bau, Bintulu, Kuching, Limbang, Marudi and Sri Aman districts (e.g., *S 4326*, *S 8891*, *S 17133*, *S 29308* and *S 47632*). Also occurring in Brunei (*Muellner et al. ANM 2048* and *BRUN 18707*) and Kalimantan (e.g., *Kostermans 8054*, *Kostermans 9965*, *Kostermans 11206*, *Kostermans & Anta 960* and *Wilkie 93349*).

Ecology. In mixed dipterocarp, peatswamp and *kerangas* forests, on white sand and sandy soil with very thin humus layer, or rocky terrain, at altitudes to 800 m.

18. *Aglaia glabriflora* Hiern

Fig. 5A–F.

(Latin, *glabrus*- = without hairs or scales, *florus* = flower)

Sect. *Aglaia*

In Hooker f., Fl. Brit. Ind. 1 (1875) 555; King *op. cit.* 63; Ridley *op. cit.* (1922) 404; Anderson *op. cit.* (1980) 248; Pannell *op. cit.* (1989) 217; Whitmore, Tantra & Sutisna *op. cit.* 222. **Lectotype** (Pannell, 1992): *Griffith 1042*, Peninsular Malaysia, Johor, Mt. Ophir (K).

Tree to 20 m tall, to 25 cm diameter, branched; sometimes flowering at 3 m tall. **Bark** smooth, dark brown, brownish yellow, yellowish grey or greenish brown, lenticellate; inner bark mid-brown or greenish white, pale red or yellow. **Sapwood** white or orange yellow; latex white or sap clear and watery. **Twigs** with numerous to dense reddish brown peltate scales at the apex, the whole shoot, including leaves, inflorescences and infructescences brown or blackish brown when dry. **Leaves** imparipinnate, to 30 cm long; leaflets below with occasional stellate scales; lateral leaflets 3–5 on each side of rachis, opposite; blades elliptical or ovate, $4\text{--}10 \times 1.5\text{--}4$ cm, base cuneate or subrounded, asymmetrical, margin finely recurved, apex acuminate-caudate, acumen obtuse often narrow and parallel-sided, to 15 mm long; midrib flattish above, prominent below; lateral veins 6–7 on each side of midrib, usually brown or black when dry; intercostal venation faint; petiolules 0.3–0.8 cm long. **Inflorescences** to 20 cm long. **Flowers** obovoid, $2\text{--}2.5 \times 1.9\text{--}2.1$ mm; *calyx without hairs or scales*; *petals 5*; staminal tube $1.7\text{--}2.3 \times 1.5\text{--}2$ mm, anthers $0.8\text{--}1 \times 0.5\text{--}0.6$ mm; ovary ovoid, $0.5\text{--}0.9 \times 0.4\text{--}0.8$ mm, densely covered with orange-brown stellate hairs,

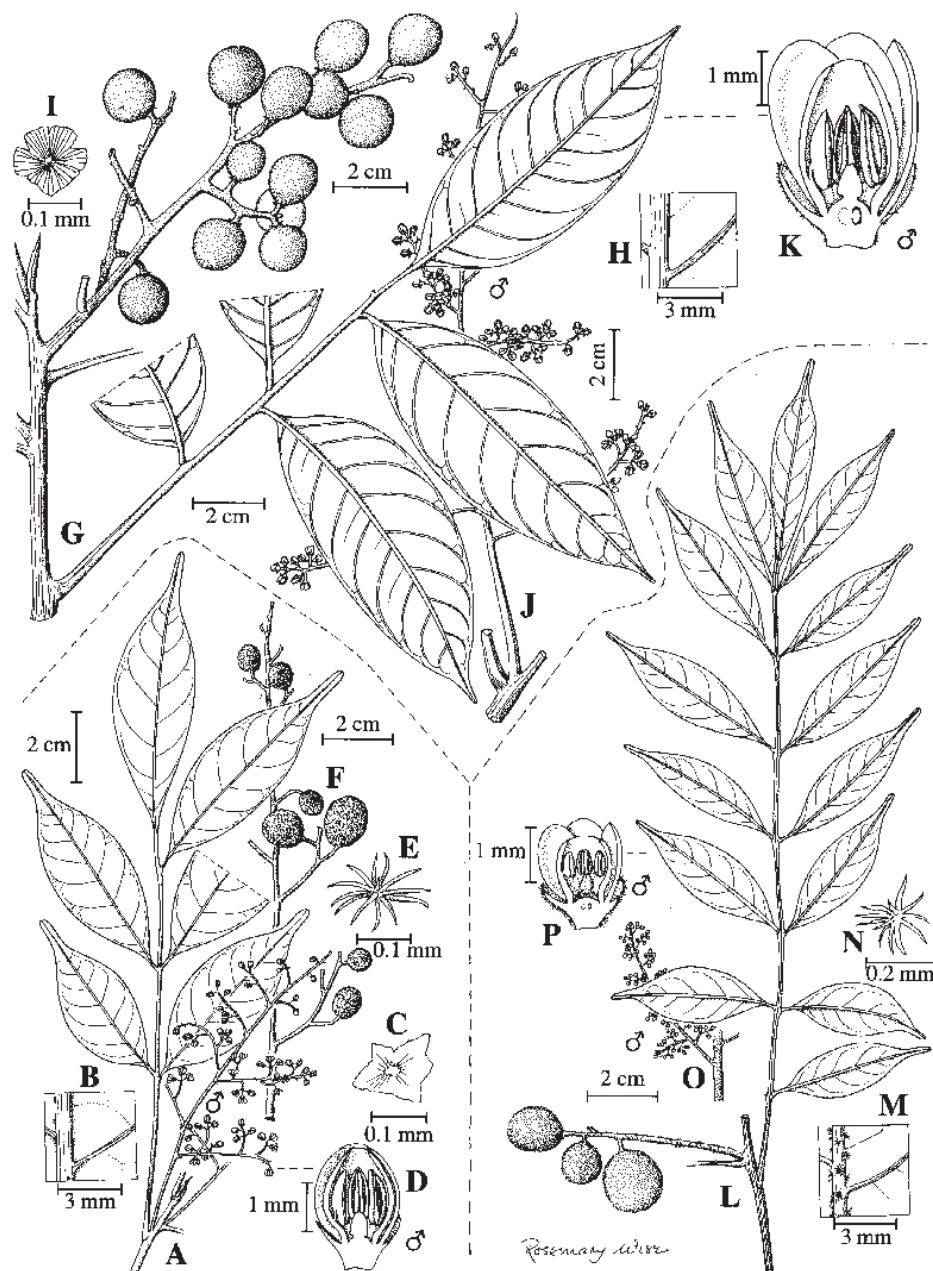


Fig. 5. *Aglaia glabriflora* (A–F), *A. leptantha* (G–K), *A. stellatopilosa* (L–P). A, leafy twig with male inflorescence; B, detail of midrib and lateral vein on the lower leaflet surface showing the indumentum; C, peltate scale; D, longitudinal section of male flower; E, stellate scale; F, infructescence; G, fruiting leafy twig; H, detail of midrib and lateral vein on the leaflet lower surface; I, peltate scale; J, male inflorescence; K, longitudinal section of male flower; L, fruiting leafy twig; M, detail of midrib and lateral vein on the lower surface showing the indumentum; N, stellate hair; O, part of male inflorescence; P, longitudinal section of male flower. (A–D from S 28012, E–F from S 39029, G–I from S 26993, J–K from SAN 76454, L from S 36491, M–N from SAN 537572, O–P from S 47672.)

locules 2, stigma 0.5–0.9 × 0.4–0.5 mm. **Fruits** indehiscent, locules 1 or 2, subglobose to ellipsoid, 1–1.5 × 1–1.5 cm, wrinkled when dry, without longitudinal ridge, densely covered with reddish brown stellate hairs.

Vernacular name. Sabah—*lantupak* (Dusun Kinabatangan).

Distribution. Sumatra, Peninsular Malaysia and Borneo (Sabah and Sarawak). In Sabah, known from Keningau, Labuk Sugut, Lahad Datu, Papar and Sipitang districts (e.g., *SAN 63164*, *SAN 83848*, *SAN 93061*, *SAN 96530* and *SAN 118491*) and in Sarawak from Belaga, Bintulu, Lundu, Miri and Sri Aman districts (e.g., *Pennington 7990*, *S 28012*, *S 39029*, *S 39322* and *S 42779*).

Ecology. In mixed dipterocarp and *kerangas* forests, on sandy clay soil, sometimes in peatswamp forest, at altitudes to 800 m.

Notes. Pannell (*op. cit.* 1992 & 1995) treated *Aglaia glabriflora* as synonym of *A. leptantha*. In the present account, however, *A. glabriflora* is recognised as a distinct species differing from *A. leptantha* in its smaller leaves and glabrous fruits and flowers.

19. *Aglaia grandis* Korth. ex Miq.

(Latin, *grandis* = large; the leaves)

Sect. *Aglaia*

Ann. Mus. Lugd. Bat. 4 (1868) 56; Merrill *op. cit.* (1921) 322; Masamune *op. cit.* 371; Pannell *op. cit.* (1989) 217, *op. cit.* (1992) 111, *op. cit.* (1995) 232; Whitmore, Tantra & Sutisna *op. cit.* 222; Turner *op. cit.* 337; PROSEA *op. cit.* (1995) 46; Beaman & Anderson *op. cit.* 121. **Lectotype** (Pannell, 1992): *Korthals s.n.*, Borneo, Kalimantan, G. Sakoembang (U [*Acc. No.* 39243]; isoelectotypes BO, K, L [*Acc. No.* 9081321502 & 9081321533]). **Synonyms:** *Aglaia lanuginosa* King *op. cit.* 71, Ridley *op. cit.* (1922) 407, Corner *op. cit.* (1978) 131; *Aglaia hemsleyi* [hemsleyi] Koord. *op. cit.* 383, 635; ?*Aglaia bernardoi* Merr. *op. cit.* (1915) 302, Anderson *op. cit.* (1980) 247, Whitmore, Tantra & Sutisna *op. cit.* 220; *Aglaia stellatotomentosa* [stellato-tomentosa] Merr. *op. cit.* (1915) 535, Anderson *op. cit.* (1980) 247; *Aglaia perfulva* Elmer *op. cit.* 3302.

Tree to 17 m tall, to 25 cm diameter, branched. **Bark** smooth, grey or blackish red, with shallow longitudinal fissures; inner bark brown, reddish brown or pink; latex white. **Sapwood** pinkish brown, reddish brown, yellow or white. **Twigs** stout, *terete*, to 4 cm diameter, with many petiole scars, *densely covered with brown hairs with a central rachis and 2–4 whorls of arms radiating from it*. **Leaves** *imparipinnate*, to 135 cm long; petioles to 20 cm long; leaflets coriaceous, upper surface shiny, *lower surface densely covered with pale brown hairs to 1 mm long like that of the twigs, with the surface visible between the hairs*; lateral leaflets (rarely 4) 5–9 on each side of rachis, subopposite; blades elliptical, obovate or oblong, 13–51 × 6.5–14 cm, base subcordate or cuneate, asymmetrical, margin recurved, apex acuminate, acumen acute, to 15 mm long; midrib impressed above, prominent below; lateral veins 17–45 on each side of midrib, impressed above, prominent below; intercostal venation faint but visible on both surfaces; petiolules to 2 cm long. **Inflorescences** to 30 cm long and to 15 cm wide, densely covered with brown hairs like that of the twigs. **Flowers** sessile, densely packed on the final branches of the inflorescence, 3–4 × 2.5–3 mm; *calyx deeply divided into 5 narrow lobes*, outside with hairs like that of the twigs; corolla 2–3.3 × 2–2.7 mm, glabrous, *petals* 5; staminal tube obovoid, 1.9–3.3 × 1.5–2.3 mm, anthers 5, 0.6–1.1 × 0.5–0.6 mm; ovary depressed globose, 0.3–0.9 × 0.3–1.1

mm, with numerous stellate hairs, locules 3, each containing 1 ovule, stigma $0.5\text{--}1.1 \times 0.5\text{--}0.6$ mm, black and shiny, cylindrical, narrowed slightly to the obtuse, 3-lobed apex. **Fruits** indehiscent, brown, 1- or 2-locular, obovoid, to 5×5.6 cm, sometimes with a small beak; pericarp with white latex, inner wall reddish brown. **Seeds** to 5.5×4.5 cm; aril white.

Distribution. Vietnam, Thailand, Peninsular Malaysia, Borneo, the Philippines and Sulawesi. In Sabah, recorded from Keningau, Kinabatangan, Labuk Sugut, Lahad Datu, Ranau, Sandakan and Tawau districts (e.g., *SAN 69489*, *SAN 73301*, *SAN 74402*, *SAN 75200* and *SAN 83177*) and in Sarawak from Belaga, Kuching and Marudi districts (e.g., *Chew CWL 1029*, *Mabberley 1606*, *S 30382* and *S 31803*). Also occurring in Kalimantan (e.g., *bb. 11718*) but not yet recorded from Brunei.

Ecology. In forests, including on limestone, at altitudes to 300 m.

20. *Aglaia hiernii* King

(William Philip Hiern, 1839–1925, British botanist)

Sect. *Aglaia*

J. As. Soc. Beng. 64, 1 (1895) 74; Ridley *op. cit.* (1922) 408; Corner *op. cit.* (1978) 131; Pannell *op. cit.* (1989) 218, *op. cit.* (1992) 341, *op. cit.* (1995) 310; PROSEA *op. cit.* (1995) 47; Turner *op. cit.* 337; Beaman & Anderson *op. cit.* 121. **Syntypes:** *Maingay 2493* (= *Kew Distr. 335*), Peninsular Malaysia, Malacca (K); *King's collectors 5976*, Perak, Gopeng (K); *King's collectors 6706*, Perak, Larut (CGE, SING, U); *King's collectors 10877*, Perak, Larut (SING). **Synonyms:** *Aglaia curtisii* King *op. cit.* 71, Anderson *op. cit.* (1980) 247, Whitmore, Tantra & Sutisna *op. cit.* 221; *Aglaia caudatifoliolata* Merr. *op. cit.* (1929) 126, Masamune *op. cit.* 370.

Tree to 30 m tall, to 30 cm diameter, branched. **Bark** greenish brown or grey with fine longitudinal lines of lenticels; inner bark green; latex white. **Sapwood** green, pink, pale yellow or white. **Twigs** fairly stout, *densely covered with dark reddish brown stellate hairs with arms to 1 mm long*. **Leaves** imparipinnate, to 70 cm long; petioles to 18 cm long; leaflets yellowish green when young, *below densely covered with stellate hairs like that of the twigs on the midrib and less so on the surface, with the arms of adjacent hairs overlapping, interspersed with numerous pale brown stellate scales or hairs with few ascending arms*; lateral leaflets (3 or) 4 (or 6) on each side of rachis, opposite; *blades obovate, elliptical or oblong, $7\text{--}30 \times 4\text{--}11$ cm*, base rounded, margin recurved, apex short-caudate, acuminate, to 15 mm long; midrib prominent below; lateral veins 12–25 on each side of midrib, subprominent below; *intercostal venation faint*; petiolules 1–2.5 cm long. **Inflorescences** densely covered with stellate hairs like that of the twigs, to 35 cm long and wide. **Flowers** sessile and tightly packed on the terminal branches of the inflorescence, subglobose, *c. 1×1 mm*; *calyx divided almost to the base into 4 or 5 subrotund lobes*, outside densely covered with stellate scales; *petals 5*; staminal tube shorter than the corolla, anthers 5, ovoid; ovary *c. 0.3 mm* diameter, stigma glabrous, black when dry. **Fruits** indehiscent, *locule 1*, containing 1 seed, obovoid or ellipsoid, *to 4×3 cm*; stalk to 0.5 cm long; *pericarp 2–4 mm thick, woody and hard when dry*, outside densely covered with stellate hairs or scales. **Seeds** *c. $2.9 \times 1.9 \times 1.7$ cm*; aril *c. 1.5 mm* thick, translucent, pale orange, sweet and edible.

Vernacular names. Sabah—*jalungang sasak* (Malay), *lantupak* (Dusun Kinabatangan and Kadazan). Sarawak—*labonoh* (Kelabit), *pulu* (Kayan), *segera* (Iban).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah, recorded from Labuk Sugut, Lahad Datu, Ranau, Sandakan, Tambunan and Tawau districts (e.g., *SAN* 29563, *SAN* 32323, *SAN* 46793, *SAN* 64990 and *SAN* 87647) and in Sarawak from Belaga, Kapit, Kuching, Marudi, Miri and Song districts (e.g., *Mabberley* 1630, *Pennington* 8009, *S* 26220, *S* 35054, *S* 39837 and *S* 50568). Also occurring in Kalimantan (e.g., *Adriansyah & Boestani* AA 2194, *Burley et al.* 778 and *Kessler et al.* PK 853) but not yet recorded from Brunei.

Ecology. In mixed dipterocarp forests, on sandy, clay, clay-loam soils, at altitudes to 1300 m.

21. *Aglaia korthalsii* Miq.

Fig. 6.

(Pieter Willem Korthals, 1807–1892, Dutch botanist and traveller)

Sect. *Aglaia*

Ann. Mus. Lugd. Bat. 4 (1868) 42; Whitmore, Tantra & Sutisna *op. cit.* 223; Pannell *op. cit.* (1992) 167, *op. cit.* (1995) 251; Turner *op. cit.* 337; Argent *et al.* (eds.) *op. cit.* 410; Beaman & Anderson *op. cit.* 121. **Lectotype** (Pannell, 1992): *Korthals* 899a, Sumatra, Doekoe (L [*Acc. No.* 9081321517]; isoelectotype L [*Acc.* 95254125]). **Synonyms:** *Hearnia sarawakana* C.DC. *op. cit.* (1878) 632; *Aglaia cauliflora* Koord. *op. cit.* 633; *Aglaia dysoxylifolia* Koord. *op. cit.* 634; *Aglaia celebica* Koord. *op. cit.* 634; *Aglaia conferitiflora* Merr. *op. cit.* (1929) 125, Whitmore, Tantra & Sutisna *op. cit.* 220; *Aglaia sarawakana* (C.DC.) Merr. *op. cit.* (1921) 323, Masamune *op. cit.* 370; *Aglaia* sp. 4, Pannell *op. cit.* (1989) 228.

Tree to 26 m tall, to 70 cm diameter, branched; buttresses (if present) to 60 cm high. **Bark** pale to dark reddish brown or pinkish brown or grey; inner bark pink, red, purplish yellow, pale grey or brown; latex white. **Sapwood** brownish yellow, yellow or white. **Twigs** longitudinally wrinkled, with pale pink lenticels, *densely covered with shiny reddish brown peltate scales with a dark centre, becoming paler towards the margin or are pale throughout with irregular or shortly fimbriate margins*. **Leaves** imparipinnate, to 40 cm long; petioles 7–12 cm long; *leaflets below sparsely to densely covered with scales like that of the twigs*, sometimes with faint reddish brown pits; lateral leaflets (1 or 2 (or 3) on each side of rachis, subopposite; *blades ovate or elliptical or sometimes obovate, 3–22 × 1.2–7.5 cm*, base rounded or cuneate, asymmetrical, *margin recurved*, apex acuminate, acumen obtuse or acute, to 15 mm long; midrib prominent below; lateral veins 7–16 on each side of midrib, subprominent below; intercostal venation inconspicuous on both surfaces; petiolules 0.5–1(–3) cm long. **Inflorescences** densely covered with peltate scales like that of the twigs; males to 40 cm long and wide; females smaller, fewer-branched. **Flowers** subglobose or depressed globose, 1.1–1.5 × 1.1–1.6 mm; *calyx divided almost to the base into 5 rounded lobes with fimbriate margins*, outside with few to numerous peltate scales like that of the twigs; *petals* 5; *staminal tube* obovoid or cup-shaped, 0.5–0.9 × 0.7–1 mm, *with an aperture of more than 0.3 mm diameter, margin shallowly lobed*, *anthers* 5, *protruding through the aperture of staminal tube*, ovoid, c. 0.3 × 0.3 mm; ovary depressed globose, 0.2–0.3 × 0.2–0.5 mm, densely covered with peltate scales, stigma ovoid, 0.2–0.3 × 0.2–0.3 mm. **Fruits** indehiscent, *locules* 2, each containing 0 or 1 seed, *with a longitudinal ridge around it along which the pericarp splits when pressure is applied*, ellipsoid, to 3.7 × 3.1 cm, reddish orange or bright red, outside densely covered with orange-brown peltate fimbriate scales.

Vernacular names. Sabah—*langsap munchit* (Sungei), *lantupak* (Dusun Kinabatangan), *lantupak burung* (Dusun Kinabatangan). Sarawak—*segera* (Iban).

Distribution. NE India (Assam), Bhutan, Nicobar Islands, Myanmar, Vietnam, S Thailand, Sumatra, Peninsular Malaysia, Borneo, the Philippines, Sulawesi and Nusa Tenggara (Sumbawa and Flores). In Sabah, known from Beaufort, Kudat, Lahad Datu, Ranau, Sandakan, Semporna, Sipitang, Tambunan and Tawau districts (e.g., *SAN* 46102, *SAN* 66865, *SAN* 72388, *SAN* 90102 and *SAN* 114026) and in Sarawak from Marudi and Miri districts (e.g., *S* 24022, *S* 27276, *S* 30422, *S* 35799, *S* 43172 and *S* 89435). Also occurring in Kalimantan (e.g., *bb*. 25877, *Goverse & Adriansyah B* 452 and *Leighton* 1009) but not yet recorded from Brunei.

Ecology. In forests, sometimes on limestone, at altitudes to 700 m. Fruits and seeds are eaten and dispersed by Orang-utans.

Taxonomy. In Borneo, *Aglaia korthalsii* and *A. odoratissima* are difficult to separate when not in fruit, because *A. korthalsii* has leaves with fewer leaflets there than in the rest of its range.

22. *Aglaia lancifolia* (Hook.f.) Harms

Fig. 3O–U.

(Latin, *lancea* = light spear, *folium* = leaf; the shape of leaflets)

Sect. *Aglaia*

In Engler & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 298; Masamune *op. cit.* 371; Anderson *op. cit.* (1980) 248; van Steenis, Rheophytes of the World (1981) 289; Whitmore, Tantra & Sutisna *op. cit.* 223. **Basionym:** *Milnea lancifolia* Hook.f., Trans. Linn. Soc. 23 (1860) 165. **Lectotype** (Pannell, 1992): Lowe *s.n.*, Borneo, Sabah (K). **Synonyms:** *Aglaiopsis lancifolia* (Hook.f.) Miq. *op. cit.* (1868) 59; *Hearnia lancifolia* (Hook.f.) C.DC. *op. cit.* (1878) 630, Merrill *op. cit.* (1921) 322; *Aglaia baramensis* Merr. *op. cit.* (1922) 317, Masamune *op. cit.* 370.

Rheophyte to 6(–9) m tall, branched; flowering at 2 m tall. **Bark** smooth, grey or brown; inner bark pale yellow. **Sapwood** whitish. **Twigs** slender, *densely covered with reddish brown stellate hairs or scales, sometimes interspersed with peltate, fimbriate scales*. **Leaves** *imparipinnate*, 16–30 cm long; petioles 6–10 cm long; *lateral leaflets (4 or) 5–8 on each side of rachis*, alternate or subopposite, *below with dense reddish brown stellate hair or scales on the midrib; blades narrowly lanceolate, 11–25 × 1–4.5 cm, mostly 5–11x longer than wide*, base cuneate, margin recurved and somewhat wavy, apex acuminate-caudate, acumen to 20 mm long; midrib impressed above, prominent below, with dense indumentum like that of the twigs; *lateral veins 9–19 on each side of midrib*, faint above, subprominent below; intercostal venation faint on both surfaces; petiolules to 1 cm long. **Inflorescences and flowers** like those of *A. elliptica* except that the *staminal tube usually divided to the base into 5 lobes*. **Fruits** *indehiscent, locules 2, each with one seed, globose, to 2.5 × 2.4 cm*, orange when ripe, with a longitudinal ridge around it, densely covered with indumentum similar to that of the twigs. **Seeds** to 2.1 × 1.3 × 0.8 cm.

Vernacular names. Sarawak—*buyau* (Punan), *embaloh* (Iban), *paybut* (Punan), *sankuang* (Iban), *segera* (Iban), *segera ayer* (Iban).

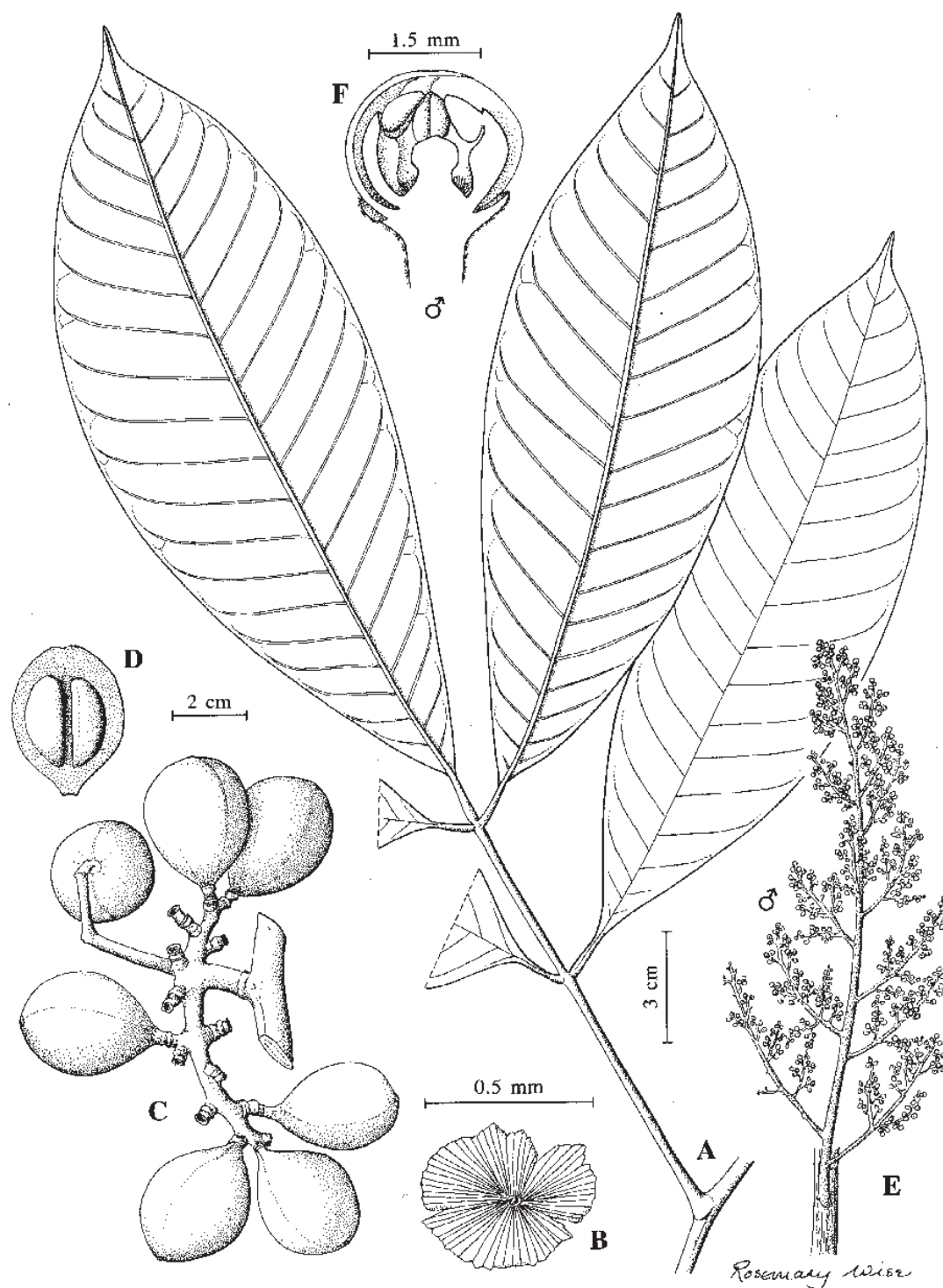


Fig. 6. *Aglaia korthalsii*. A, leaf; B, peltate scale; C, part of infructescence; D, opened fruit showing the seeds; E, male inflorescence; F, longitudinal section of male flower. (After Pannell, Kew Bull. Add. Series 16 (1992) 171, f. 41; A–D from Pannell 1972, E from de Wilde 19198, F from de Wilde 14823.)

Distribution. Endemic in Borneo. In Sabah, recorded from Beaufort, Lahad Datu and Sipitang districts (e.g., *SAN 78181*, *SAN 129531* and *SAN 138405*) and in Sarawak from Kapit, Limbang, Lubok Antu, Miri, Marudi and Sri Aman districts (e.g., *Pennington 7998*, *S 27297*, *S 34079*, *S 41359* and *S 51990*). Also occurring in Brunei (e.g., *Atkin 469*, *Kirkup DK 947*, *Schatz et al. 3282* and *Wong WKM 236*) and in Kalimantan (e.g., *Church et al. 504*, *Church et al. 5494*, *Mogea 3702*, *Ridsdale PBU 358A* and *Sidiyasa et al. BRF 1782*).

Ecology. Frequent on river banks. One specimen (*S 22913*) is reported to be an epiphyte about 16 m up a tree. The orange seed, surrounded by a transparent aril is eaten by fish (*vide P. S. Ashton on Pennington 7998*).

Notes. This species was treated as a synonym of *Aglaia elliptica* by Pannell (*op. cit.* 1992 & *op. cit.* 1995). It is here recognized as a distinct, but closely related species differing from *A. elliptica* in its long, narrow leaflets and staminal tube divided almost to the base.

23. *Aglaia lancilimba* Merr.

(Latin, *lancea* = light spear, *limbus* = border; the narrow recurved margin of leaflets)

Sect. *Aglaia*

Philip. J. Sci., Bot. 13 (1918) 294; Pannell *op. cit.* (1992) 137, *op. cit.* (1995) 242. **Lectotype** (Pannell, 1992): *De Mesa & Magistrado FB 26509*, the Philippines, Luzon, Camarines Province (US; isoelectotypes K, P, PNH).

Tree to 15 m tall, branched. **Twigs** densely covered with large shiny reddish brown peltate scales which are entire or with a short fimbriate margin and often with a dark centre and a dark ring near the margin, the scales usually 0.2–0.6 mm diameter. **Leaves** imparipinnate, 18–50 cm long; petioles 2.5–12 cm long; leaflets pale yellowish brown when dry, lower surface with numerous pits, the midrib thickly covered with scales like that of the twigs, sometimes interspersed with a few paler and more fimbriate scales, occasionally also on the rest of that surface; lateral leaflets (3–)4–6(–8) on each side of rachis, subopposite or alternate; blades elliptical, 5–18 × 1.5–5.5 cm, base cuneate or rounded, asymmetrical, margin recurved or undulate, apex acuminate, acumen obtuse, 2–25 mm long; midrib prominent below; lateral veins 6–17 on each side of midrib, barely subprominent; intercostals venation faint; petiolules 0.5–2 cm long. **Inflorescences** to 28 cm long, to 23 cm wide, densely covered with scales like that of the twigs or with scales with a longer fimbriate margin or with stellate scales. **Flowers** 1.5–3 × 1.5–3.5 mm; calyx divided into 5 lobes, outside densely covered with scales like that of the twigs; petals 5; staminal tube shallowly cup-shaped, to c. 1 × 1–2 mm, thickened below and between the anthers, anthers 5, 0.4–0.5 × 0.4–0.5 mm, dark blackish brown when dry, with a pale yellow margin; ovary 0.4–1 × 0.6–1 mm, depressed globose, locules 2, each containing 2 ovules, stigma ovoid, 0.2–0.3 × 0.3–0.4 mm, truncate at the apex. **Fruits** indehiscent, locules 2, each containing one seed, subglobose, 2.2–3 × 2.2–3 cm, brown or yellow when ripe; pericarp thin and brittle when dry, outside densely covered with scales like that of the twigs. **Seeds** covered with a white aril.

Distribution. Borneo, the Philippines, Sulawesi and Nusa Tenggara (Bali, Flores and Sumbawa). In Borneo, only known from Bumbun Island, Semporna district, Sabah (e.g., *SAN 146*, *SAN 10128* and *SAN 10279*).

Ecology. In primary forest.

24. *Aglaia lawii* (Wight) C.J.Saldanha ex Ramamoorthy

(John Sutherland Law, 1810–1885, British Civil Servant in Bombay, India)

Sect. *Neoaglaia*

In Saldanha & Nicolson, Flora of Hassan District (1976) 392; Pannell *op. cit.* (1992) 97, *op. cit.* (1995) 228; PROSEA *op. cit.* (1995) 47; Turner *op. cit.* 337; Argent *et al.* (eds.) *op. cit.* 410. **Basionym:** *Nimmonia lawii* Wight, Calc. J. Nat. Hist. 7 (1847) 13 (*nom. nov. pro Epicharis exarillata* J.Graham, *non* Arn.). **Neotype** (Pannell, 1992): *Law s.n.*, India, Bombay (K; isoneotype CGE). **Synonyms:** *Aglaia submonophylla* Miq. *op. cit.* (1868) 40, Merrill *op. cit.* (1921) 323, Masamune *op. cit.* 373; *Aglaia oligocarpa* Miq. *op. cit.* (1868) 45, Pannell *op. cit.* (1989) 221, Whitmore, Tantra & Sutisna *op. cit.* 224; *Lansium pedicellatum* Hiern *op. cit.* 588; *Amoora maingayi* Hiern *op. cit.* 562, Ridley *op. cit.* (1922) 400; *Aglaia maingayi* (Hiern) King *op. cit.* 79; *Aglaia eusideroxylon* Koord. & Valetton *op. cit.* (1896) 128, Koorders & Valetton *op. cit.* (1913) t. 97, Backer & Bakhuizen *f. op. cit.* 127, Whitmore, Tantra & Sutisna *op. cit.* 221; *Amoora lepidota* Merr. *op. cit.* (1904) 23; *Aglaia alternifoliola* Merr. *op. cit.* (1915) 532; *Aglaia grandifoliola* Merr. *op. cit.* (1918) 293; *Aglaia trimera* Merr. *op. cit.* (1929) 128; *Aglaia racemosa* Ridl. *op. cit.* (1930) 367; *Aglaia pedicellata* (Hiern) Kosterm., Reinwardtia 7, 3 (1966) 226 & 264.

Distribution. India, Bhutan, China, Indo-China, Thailand, Sumatra, Peninsular Malaysia, Borneo and the Philippines.

Notes. *Aglaia lawii* is the most variable and widespread species in the genus. Three subspecies, viz. subsp. *lawii*, subsp. *oligocarpa* and subsp. *submonophylla* are recognised. Whereas subsp. *lawii* does not occur in Borneo, and subsp. *oligocarpa*, is known in Thailand, Sumatra, Peninsular Malaysia, Borneo and the Philippines, subsp. *submonophylla* has been recorded only from Kalimantan.

subsp. ***oligocarpa*** (Miq.) Pannell
(Greek, *oligo-* = few, *karpós* = fruit)

Kew Bull. 59 (2004) 90. **Basionym:** *Aglaia oligocarpa* Miq. *op. cit.* (1868) 45, Pannell *op. cit.* (1989) 221, Whitmore, Tantra & Sutisna *op. cit.* 224. **Lectotype** (Pannell, 1992): *Junghuhn 41*, Sumatra, Angkola Province (L [Acc. No. 9081321568]; isoelectotype L [Acc. No. 908329629]). **Synonyms:** *Amoora maingayi* Hiern *op. cit.* 562, Ridley *op. cit.* (1922) 400; *Aglaia maingayi* (Hiern) King *op. cit.* 79; *Aglaia trimera* Merr. *op. cit.* (1929) 128; *Aglaia racemosa* Ridl. *op. cit.* (1930) 367.

Tree to 30 m tall, to 40 cm diameter, branched; sometimes flowering when *c.* 2.5 m tall; buttresses (if present) to 90 cm high, to 50 cm out. **Bark** reddish brown, dark brown, grey, greyish brown, greenish brown, pale green, pale yellow or white; inner bark pale green, pale yellow, pale orange-brown, red, pink or white; latex white. **Sapwood** pale brown, yellow or white, sometimes pinker towards the heartwood. **Twigs** slender, longitudinally ridged, sometimes with numerous elliptical brown lenticels, *densely covered with very pale brown to almost white peltate scales with irregular or fimbriate margins and sometimes with a dark brownish black central spot*. **Leaves** *imparipinnate*, to 66 cm long; petioles to 16 cm long; *leaflets below occasionally with peltate scales, not or only faintly pitted, blackish green, pale green, yellowish green or pale yellow when dry; lateral leaflets 1–3 on each side of rachis, alternate or subopposite, terminal ones not folded at the base; blades*

elliptical, ovate or obovate, 5–23(–32) × (2–)2.5–8.5(–11) cm, base broadly cuneate, rounded, attenuate or cordate, slightly asymmetrical, margin recurved and undulate, apex acuminate or acuminate-caudate, acumen obtuse, 5–25 mm long; midrib prominent below; lateral veins (6–)10–14(–20) on each side of midrib, prominent below, not turning black when dry; intercostal venation barely visible or subprominent below; petiolules 0–2 cm long. Inflorescences axillary or ramiflorous, 2.5–22 cm long, 1.5–20 cm wide, densely covered with scales or hairs like that of the twigs. **Flowers** (1.5–)1.8–3 × (1.6–)1.7–3.5 mm; *calyx shallowly divided into 3 or 4 (rarely 6) obtuse lobes; corolla a short tube connate with the base of the staminal tube, divided into 3 or 4 subrotund lobes; staminal tube (0.8–)1.5–2.5 × (0.7–)1.3–3 mm, sometimes thickened below the insertion of the anthers, anthers (4–)6–9, ovoid, (0.3–)0.5–0.8 × (0.3–)0.4–0.7 mm; ovary subglobose or ovoid, (0.3–)0.5–0.7 × (0.3–)0.6–1 mm, locules 3, each containing 2 ovules, stigma ovoid or columnar, 0.2–0.6 × 0.3–0.5 mm, with 3 apical lobes or truncate at the apex. Fruits* subglobose, 2–2.9 cm across, with three longitudinal ridges along which the pericarp dehisces; *locules 3, each containing 0 or 1 seed; outer pericarp pink or yellow, inner pericarp white. Seeds* 1.5–2.3 × 1–1.4 cm, with an orange or orange-red aril.

Vernacular names. Sabah—*lantupak* (Dusun Kinabatangan). Sarawak—*segera* (Iban).

Distribution. Thailand, Sumatra, Peninsular Malaysia, Borneo and the Philippines. In Borneo, known in Sabah from Keningau, Kinabatangan, Kudat, Papar, Ranau, Sandakan, Sipitang and Tenom districts (e.g., *Pennington* 7943, *SAN* 28984, *SAN* 41153, *SAN* 41403 and *SAN* 86774) and in Sarawak from Bau, Betong, Kapit, Kuching, Miri and Serian districts (e.g., *Jacobs* 5438, *Mabberley* 1625, *S* 22785, *S* 28106, *S* 32629 and *S* 40267). Also occurring in Brunei (e.g., *BRUN* 5177) and Kalimantan (e.g., *Laman et al.* 1121, *Laman et al.* 1225, *Laman et al.* 1402, *Veldkamp* 8278 and *Veldkamp* 8563).

Ecology. In *kerangas* and mixed dipterocarp forests, sometimes in peat swamp or on limestone forests at altitudes to 600 m. In Peninsular Malaysia, the seeds are eaten and thought to be dispersed by birds ranging in size from bulbuls (Pycnonotidae) to magpies (Corvidae) and hornbills (Bucerotidae).

25. *Aglaia laxiflora* Miq.

(Latin, *laxus* = loose, *florus* = flower; the well-spaced arrangement of the flowers in the inflorescence)

Sect. *Aglaia*

Ann. Mus. Bot. Lugd. Bat. 4 (1868) 52; Ridley, J. Str. Br. Roy. As. Soc. 63 (1912) 59; Merrill *op. cit.* (1921) 322; Pannell *op. cit.* (1992) 294, *op. cit.* (1995) 294; Coode *et al.* (eds.) *op. cit.* 201. **Lectotype** (Pannell, 1992); *Korthals s.n.*, Borneo, Kalimantan, Doesoen (L [Acc. No. 9081321677]; isoelectotype BO).

Tree to 10 m tall or more, to 35 cm diameter, branched. **Bark** light grey with numerous orange-brown depressions and scalloped pattern; inner bark reddish pink, laminated. **Sapwood** whitish pink, with tiny rays. **Twigs** with numerous lenticels, *densely covered with small pale brown stellate scales at the apex. Leaves* imparipinnate, to 60 cm long; petioles to 11 cm long; *leaflets pale green above and pale brownish green below when dry, below with few to numerous scales like that of the twigs on the midrib and few on the rest of that*

surface; lateral leaflets 5–7 on each side of rachis, alternate, basal ones only slightly smaller than the rest; blades narrowly elliptical or oblong, $5\text{--}24 \times 2\text{--}8$ cm, base cuneate or rounded, margin recurved, apex acuminate, acumen to 15 mm long; midrib prominent below; lateral veins 8–15 on each side of midrib, subprominent below; *intercostal venation subprominent on both surfaces*; petiolules 0.5–2 cm long. **Inflorescences** sparsely covered with stellate scales like those on the twigs; branches slender and widely spaced giving the inflorescence a lax appearance; males to 56 cm long and to 40 cm wide; females not seen. **Male flowers** $1.1\text{--}1.2 \times 1.2\text{--}1.3$ mm; calyx with 5 spreading rounded lobes with a ciliate margin, without hairs or scales; petals 5; staminal tube cup-shaped, $0.5\text{--}0.9 \times 0.9\text{--}1$ mm, apical margin incurved, anthers 5, ovoid, $0.3\text{--}0.4 \times 0.3$ mm, dehiscent only in the lower half, darker at the apex; ovary $0.2\text{--}0.4 \times 0.3$ mm, locules 2, each containing 1 ovule, with a dense ring of pale stellate scales at the junction with the stigma, stigma ovoid with two tiny apical lobes, c. 0.2×0.2 mm. **Fruits indehiscent**, locules 2, each containing 0 or 1 seed, ellipsoid or obovoid, $5\text{--}6 \times 3.5$ cm, orange or orange-yellow when ripe; pericarp 3–5 mm thick; the fruit curved and asymmetrical when a seed fails to develop in one of the locules. **Seeds** c. $3.1 \times 1.8 \times 1$ cm, surrounded by an entire translucent aril 2–3 mm thick.

Vernacular name. Sabah—*lantupak* (Dusun Kinabatangan).

Distribution. Endemic in Borneo. In Sabah, known from Keningau, Lahad Datu and Tawau districts (e.g., *SAN 39965*, *SAN 47759*, *SAN 70926*, *SAN 84862* and *SAN 112145*) and in Sarawak from Belaga and Miri districts (e.g., *Geh & Samsuri 116* and *Stone 13726*). Also occurring in Brunei (e.g., *Forman 1137* and *Sands 5912*) and Kalimantan (e.g., *Leighton 898* and *Nooteboom 4427*).

Ecology. Common in mixed dipterocarp forest, along ridges and river banks, on alluvial or sandy soils, sometimes also on limestone hills or swampy ground, at altitudes to 1650 m.

26. *Aglaia leptantha* Miq.

Fig. 5G–K.

(Greek, *lepto-* = narrow, *anthos* = flower; flower is ellipsoid rather than subglobose as is usually in the genus)

Sect. *Aglaia*

Ann. Mus. Bot. Lugd. Bat. 4 (1868) 51; Merrill *op. cit.* (1921) 322; Masamune *op. cit.* 372; Pannell *op. cit.* (1992) 201, *op. cit.* (1995) 261; PROSEA *op. cit.* (1995) 48; Turner *op. cit.* 337; Coode *et al.* (eds.) *op. cit.* 201; Beaman & Anderson *op. cit.* 121. **Lectotype** (Pannell, 1992): *Korthals s.n.*, Sumatra (L [Acc. No. 9081321697]; isoelectotypes BO, K). **Synonyms:** *Aglaia leptantha* [*lepantha*] Miq. var. *borneensis* C.DC. *op. cit.* (1878) 604, Masamune *op. cit.* 372, Anderson *op. cit.* (1980) 247; *Aglaia laevigata* Merr., Philip. Gov. Lab. Bur. Bull. 35 (1906) 31; *Aglaia multiflora* Merr., Philip. J. Sci. 1, Suppl. (1906) 73; *Aglaia glabrifolia* Merr. *op. cit.* (1929) 129, Masamune *op. cit.* 371; *Aglaia gamopetala* Merr. *op. cit.* (1929) 126, Masamune *op. cit.* 371, Anderson *op. cit.* (1980) 248, Pannell *op. cit.* (1989) 216, Whitmore, Tantra & Sutisna *op. cit.* 222.

Tree to 12 m tall, to 25 cm in diameter, branched. **Bark** pale grey, greyish brown or brown; inner bark green, pale orange-brown or reddish brown. **Sapwood** brown, yellowish brown or

pale orange-brown; latex white. **Twigs** densely covered with reddish brown, pale brown or grey peltate scales with fimbriate margins, when pale, the scales sometimes with a dark grey central spot. **Leaves** imparipinnate, 30–83 cm long; petioles 6.5–16 cm long; leaflets below sparsely to densely covered with scales like that of the twigs on the midrib, sparsely so on the lateral veins and rarely on the surface in between, sometimes with numerous pits on both surfaces; lateral leaflets 2–4 on each side of rachis, alternate; blades elliptical, ovate, oblong, oblanceolate, rarely obovate, $4.5\text{--}21 \times 2.1\text{--}7$ cm, base broadly cuneate, rounded rarely subcordate, asymmetrical, margin planar to slightly recurved, apex acuminate-caudate, acumen to 20 mm long; midrib prominent below, flat to slightly prominent above; lateral veins 9–13 on each side of midrib, black, blackish brown or reddish brown when dry; intercostal venation faint on both surfaces, visible below; petiolules 0.2–1 cm long on lateral leaflets, to 2.5 cm long on terminal leaflets. **Inflorescences** to 40 cm long and wide; peduncles to 10 cm long, with indumentum like that of the twigs. **Flowers** $1.7\text{--}4.5 \times 1.3\text{--}3$ mm; calyx 5-lobed, outside with dense cover of scales; petals 5; staminal tube slightly shorter or longer than the corolla, obovoid, $1\text{--}4 \times 1\text{--}2.6$ mm, anthers narrowly ovoid, $0.5\text{--}1.6 \times 0.3\text{--}0.7$ mm; ovary depressed globose, $0.3 \times 0.1\text{--}0.5$ mm, densely covered with stellate hairs or scales, locules 1 or 2, stigma ovoid with two small apical lobes, $0.2\text{--}0.6 \times 0.3$ mm. **Infructescences** to 70 cm long. **Fruits** indehiscent, locules 1 or 2, each containing 1 seed, yellow or orange when ripe, ellipsoid or subglobose, $1.2\text{--}3.2 \times 1.2\text{--}3$ cm, sometimes laterally compressed, with a longitudinal ridge around it, outside densely covered with pale brown stellate scales; pericarp either thin or hard and woody to 5 mm thick. **Seeds** ovoid with the inner surface flattened, to $2.3 \times 1.4 \times 1$ cm; aril gelatinous translucent, edible.

Vernacular names. Sabah—*langsats*-*langsats* (Malay), *lantupak* (Dusun Kinabatangan). Sarawak—*segera* (Iban).

Distribution. Thailand, Sumatra, Peninsular Malaysia, Singapore, Borneo, the Philippines and Nusa Tenggara (Flores). In Sabah, recorded from Beaufort, Lahad Datu, Labuk Sugut, Papar, Ranau, Sandakan and Tawau districts (e.g., *SAN* 30585, *SAN* 61208, *SAN* 67662, *SAN* 76454 and *SAN* 83185) and in Sarawak from Bau, Kuching, Limbang, Lundu, Miri and Simunjan districts (e.g., *S* 13377, *S* 26993, *S* 25689, *S* 27697 and *S* 39576). Also occurring in Kalimantan (e.g., *Kostermans* 9184 and *Kostermans* 10262) but not yet recorded from Brunei.

Ecology. In mixed dipterocarp forest at altitudes to 650 m.

Notes. The complex species *Aglaia leptantha* of Pannell (*op. cit.* 1992) is here resolved for Borneo into three distinct species, viz. *A. leptantha*, *A. glabriflora* and *A. stellatopilosa*, with the latest endemic in Borneo.

27. *Aglaia leucophylla* King

(Greek, *leukos* = white, *phyllon* = leaf; leaflets are pale yellow when dry)

Sect. *Aglaia*

J. As. Soc. Beng. 64, 1 (1895) 66; Ridley *op. cit.* (1922) 403; Pannell *op. cit.* (1989) 218, *op. cit.* (1992) 226, *op. cit.* (1995) 271; Whitmore, Tantra & Sutisna *op. cit.* 223; PROSEA *op. cit.* (1995) 48; Turner *op. cit.* 337; Coode *et al.* (eds.) *op. cit.* 201; Beaman & Anderson *op. cit.* 121. **Syntypes:** *King's collectors* 1874, Peninsular Malaysia, Perak, Larut (n.v.), *King's collectors* 2998, Perak, Larut

(K), *King's collectors* 6494 (K); *Wray Jr.* 2935, Perak, Asam Kumbong (SING, W). **Synonyms:** *Aglaia kunstleri* King *op. cit.* 69; *Aglaia heteroclita* King *op. cit.* 78, Ridley *op. cit.* (1922) 410; *Aglaia elmeri* Merr. *op. cit.* (1929) 127, Masamune *op. cit.* 371; *Aglaia simplex* Merr. *op. cit.* (1929) 128, Masamune *op. cit.* 373.

Tree to 25 m tall, to 26 cm diameter, branched; bole sometimes fluted at base or with low narrow buttresses. **Bark** smooth, grey, brown, reddish brown or greyish brown, sometimes flaking; inner bark pale yellow or pink; latex white. **Sapwood** yellow, reddish brown or white. **Twigs** slender to fairly stout, with shallow longitudinal wavy ridges, *densely covered with golden-brown or brown stellate scales*. **Leaves** *imparipinnate*, to 80 cm long; petioles to 22 cm long; *leaflets often rugulose on both surfaces, pale green or yellowish green when dry, lower surface with numerous reddish brown pits and sparsely to densely covered with tiny golden-brown stellate scales, sometimes interspersed with darker peltate scales or reddish brown stellate hairs (with arms of adjacent hairs not overlapping); lateral leaflets 3–7(or 8) on each side of rachis*, alternate or subopposite; *blades elliptical-ovate or obovate, 5–28 × 2.5–10 cm, base rounded or cuneate*, asymmetrical, *margin planar*, apex acuminate or caudate, acumen acute or obtuse, to 25 mm long; midrib prominent below; lateral veins (5–)7–16(–22) on each side of midrib, visible above, subprominent below, *black or dark brown when dry; intercostal venation visible below*; petiolules 0.1–2 cm long, sparsely to densely covered with scales like that of the twigs. **Inflorescences** *robust, covered with a few to numerous golden-brown stellate scales*; males to 60 cm long and to 25 cm wide; females *c.* 8 cm long and *c.* 2.5 cm wide. **Flowers** (0.8–)1.2–3 × 0.9–3 mm; *calyx divided into 5 lobes*, outside with a few to a dense cover of golden-brown stellate hairs; *petals* 5; staminal tube cup-shaped, 0.5–1.3 × 1–1.6 mm, anthers 5 (or rarely 6), ovoid, 0.4–0.7 × 0.2–0.5 mm; ovary depressed globose, 0.2–0.6 × 0.3–0.8 mm, densely covered with orange-brown stellate hairs, locules 2, each containing 1 ovule, stigma ovoid, 0.1–0.6 × 0.2–0.8 mm. **Fruits** *indehiscent, locules 2, each containing 0 or 1 seed, densely covered with stellate scales, either pear-shaped or subglobose, to 3.7 × 2.7 cm*, with white, thin, brittle pericarp or *pear-shaped to 3.4 × 2.5 cm*, with stalk *c.* 4 mm long and beak *c.* 2 mm long; pericarp thick, hard, woody, yellow, brown or reddish brown. **Seeds** *c.* 2.3 × 1 cm; aril white or red, edible, sweet or sour; testa brown.

Vernacular names. Sabah—*langsap hutan* (Malay), *langsap-langsap* (Malay), *lantupak* (Dusun Kinabatangan). Sarawak—*pangak* (Kenyah), *segera* (Iban).

Distribution. S Thailand, Sumatra, Peninsular Malaysia, Borneo, the Philippines and Sulawesi. Common in Borneo. In Sabah, known from Keningau, Kinabatangan, Kota Belud, Kota Merudu, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Sipitang and Tawau districts (e.g., *SAN* 62443, *SAN* 72649, *SAN* 81379, *SAN* 94398 and *SAN* 120738) and in Sarawak from Bau, Kapit, Kuching, Limbang, Lubok Antu, Miri, Mukah, Serian, Simunjan, Song and Tatau districts (e.g., *S* 25175, *S* 34377, *S* 40292, *S* 42375 and *S* 43171). Also occurring in Brunei (e.g., *BRUN* 5095, *BRUN* 5663, *Kirkup* DK 923 and *SAN* 17092) and Kalimantan (e.g., *Church et al.* 1019, *Tuke* P2 419, *Wilkie* 968, *Wilkie* 93140 and *Wilkie* 93364).

Ecology. In forests on basalt-derived, leached yellow clay, sandy or sandy clay loam soils, at altitudes to 1200 m.

28. *Aglaia luzoniensis* (Vidal) Merr. & Rolfe (of Luzon, the Philippines)

Sect. **Aglaia**

Philip. J. Sci., Bot. 3 (1908) 105; Merrill *op. cit.* (1929) 124; Masamune *op. cit.* 372; Pannell *op. cit.* (1992) 242, *op. cit.* (1995) 277; Whitmore, Tantra & Sutisna *op. cit.* 223; PROSEA *op. cit.* (1995) 48; Beaman & Anderson *op. cit.* (1980) 122. **Basionym:** *Beddomea luzoniensis* Vidal, Rev. Pl. Vasc. Filip. (1886) 84. **Lectotype** (Pannell, 1992): *Vidal 169*, the Philippines, Tayabas, Province Quezon (A; isolectotypes K, L). **Synonyms:** *Aglaia unifoliolata* Koord. *op. cit.* 383, 635; *Aglaia monophylla* J.Perkins, Fragm. Fl. Philip. (1904) 33; *Aglaia brevipetiolata* Merr. *op. cit.* (1916) 14; *Aglaia rizalensis* Merr. *op. cit.* (1918) 289.

Tree to 10 m tall, to 15 cm diameter, branched. **Bark** smooth or lenticellate, brown or red, soft; inner bark red or reddish brown, soft. **Sapwood** pale brown, white or reddish brown. **Twigs** apices densely covered with orange brown or reddish brown peltate scales which sometimes with fimbriate margins. **Leaves** simple, the midrib below densely covered with peltate scales like that of the twigs and sparsely or densely so on the lower surface and sometimes interspersed with paler brown scales; blades elliptical, 5–23 × 2–6.5(–8) cm, base cuneate, margin planar, apex acuminate, acumen obtuse, to 10 mm long; midrib prominent below; lateral veins 5–18 on each side of midrib, curving upwards, not or just anastomosing, subprominent below; intercostal venation faint on both surfaces; petioles 1–3 cm long, thickened at both ends. **Inflorescences** densely covered with scales like that of the twigs; males to 19 cm long, to 9 cm wide; females 2.5–8 cm long, 1–4 cm wide. **Flowers** 1–1.5 × 1–1.5 mm; calyx divided into 5 ovate lobes with fimbriate margins, outside densely covered with scales like that of the twigs; petals 5 (or rarely 6), yellow; staminal tube cup-shaped, 0.5–0.6 × 1 mm, margin incurved, anthers 5, 0.2–0.5 × 0.2–0.5 mm; ovary depressed globose, 0.2 × 0.3–0.4 mm, densely covered with peltate scales, stigma ovoid or depressed globose, 0.2–0.3 × 0.3–0.4 mm, sometimes with a central depression at the apex. **Fruits** indehiscent, locules 1 or 2, each containing one seed, subglobose, 1.8–2 × 1.4–1.5 cm, dark brown, reddish brown, pale orange or yellow, outside densely covered with peltate scales. **Seeds** c. 0.6 × 0.4 cm; aril c. 2 mm thick, translucent.

Vernacular names. Sabah—*langsatsat* (Malay), *langsatsat monyet* (Malay), *lantupak* (Dusun Kinabatangan).

Distribution. Borneo, the Philippines and Sulawesi. In Borneo, known only in Sabah from Keningau, Kinabatangan, Labuk Sugut, Lahad Datu, Nabawan, Pitas, Ranau, Sandakan, Tawau and Tenom districts (e.g., *SAN 35382*, *SAN 79944*, *SAN 83068*, *SAN 95549* and *SAN 121241*), in Sarawak from Kapit, Miri and Tatau districts (e.g., *Chew CWL 1034*, *S 28237*, *S 31768* and *S 84309*) and in Kalimantan (e.g., *Nooteboom 4548*).

Ecology. In forests on sandstone-derived, sandy alluvial, sandy, limestone-derived, clay, volcanic clayey soils, at altitudes to 1400 m.

29. *Aglaia macrocarpa* (Miq.) Pannell

(Greek, *makros* = large, *karpus* = fruit)

Plates 3A–C.

Sect. **Amoora**

Kew Bull. Add. Ser. 16 (1992) 65, *op. cit.* (1995) 215; PROSEA *op. cit.* (1995) 49; Turner *op. cit.* 337; Beaman & Anderson *op. cit.* 122. **Basionym:** *Epicharis macrocarpa* Miq. *op. cit.* (1861) 196, 505. **Lectotype** (Pannell, 1992): *Diepenhorst 3090*, Sumatra, Priaman (U; isolectotypes BO, L).

Synonyms: *Amoora rubescens* Hiern *op. cit.* 561, King *op. cit.* 57, Ridley *op. cit.* (1922) 399; *Aglaia trimera* auct. non Merrill (1929): Ridley *op. cit.* (1930) 368; *Aglaia triplex* Ridl., Bull. Misc. Inform. Kew (1938) 215; *Aglaia rubescens* (Hiern) Pannell, Mal. For. 45 (1982) 455, *op. cit.* (1989) 223, Whitmore, Tantra & Sutisna *op. cit.* 224.

Tree to 35 m tall, to 68 cm diameter, branched; buttresses (if present) upwards to 95 cm and outwards to 100 cm. **Bark** brown, pale brown, pinkish orange, greyish brown or white or pale, flaking in large irregular scales up to 10 cm long and 6 cm wide and with numerous orange or reddish brown lenticels, some in longitudinal rows; inner bark pink or pale brown; latex white. **Sapwood** pinkish brown, white or yellow; latex brownish yellow. **Twigs** fairly stout, *apices densely covered with minute reddish brown or grey peltate fimbriate scales which are deciduous and leaving dark reddish brown pits*. **Leaves** imparipinnate, to 70 cm long; petioles to 20 cm long; leaflets coriaceous, *both surfaces usually rugulose, sometimes smooth, upper surface pale reddish brown and dull when dry, lower surface with few minute reddish brown scales sometimes interspersed with pale grey peltate scales on the midrib and lateral veins; lateral leaflets 4–5(–7) on each side of rachis, subopposite, terminal ones not folded at the base; blades ovate, obovate, elliptical or oblanceolate, 6–21 × 2–6 cm, base rounded or cuneate, slightly asymmetrical, margin planar, apex acuminate or caudate, acumen obtuse or acute, to 15 mm long; midrib impressed above, slightly prominent below; lateral veins (6–)7–10(–15) on each side of midrib, impressed above, subprominent below; intercostal venation faint below; petiolules 1.5–2 cm long*. **Inflorescences** to 30 cm long, to 20 cm wide, densely covered with peltate fimbriate scales like that of the twigs. **Flowers** obovoid, 2–3.5 × 1.6 mm; *calyx divided almost halfway into 3 lobes, outside densely covered with dark brown stellate scales; petals 3; staminal tube shorter than the corolla, subglobose, c. 1.5 mm diameter, anthers 6, ellipsoid or narrowly ovoid, c. 0.5 mm long; ovary depressed globose, 0.75–1 mm across, densely covered with stellate scales, stigma ovoid*. **Fruits** obovoid, to 7.5 × 7.3 cm, bright red and orange or pinkish yellow, *dehiscing into 3 lobes when ripe, locules 3, each containing 0 or 1 seed; pericarp longitudinally wrinkled and moulded around the seeds when dry*. **Seeds** 4.2–5.4 × 2.3–3 × 2–2.5 cm, with a complete red, orange or white aril 1–3 mm thick; testa brown.

Vernacular names. Sabah—*lantupak* (Dusun Kinabatangan). Sarawak—*segera* (Iban).

Distribution. Vietnam, Sumatra, Peninsular Malaysia, Singapore, Borneo, the Philippines (Palawan), Java, Sulawesi and Maluku (Halmaheira and Seram). In Sabah, known from Keningau, Lahad Datu, Tawau and Tenom districts (e.g., SAN 61855, SAN 73522, SAN 77020, SAN 79703 and SAN 92178) and in Sarawak from Belaga, Bintulu, Kapit and Miri districts (e.g., S 19078, S 27045, S 39195, S 43133 and S 45445). Also known in Brunei (e.g., Muellner et al. ANM 2006) and Kalimantan (e.g., de Vogel 1028, Kostermans 7388 and Kostermans 10623).

Ecology. In mixed dipterocarp forest on hillsides, at altitudes to 400 m.

30. *Aglaia malaccensis* (Ridl.) J.A.R.Anderson (of Malacca, Peninsular Malaysia)

Sect. *Amoora*

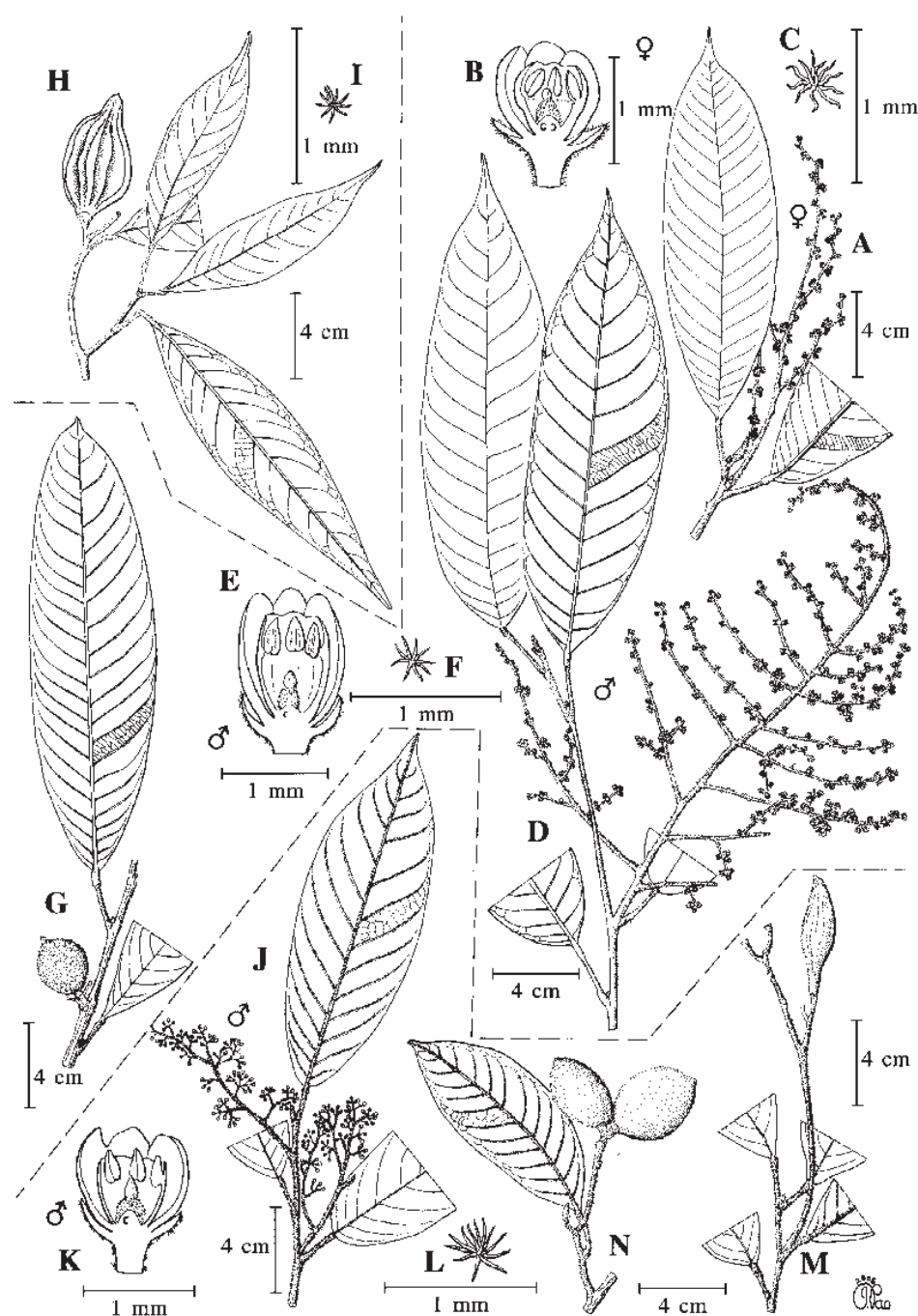


Fig. 7. *Aglaia meliosmoides* (A–G); *A. neotenica* (H–I); *A. sterculioides* (J–N). A, leafy shoot with female inflorescence; B, longitudinal section of female flower; C, stellate hair; D, leafy shoot with male inflorescence; E, longitudinal section of male flower; F, stellate hair; G, leafy shoot with fruit; H, leafy shoot with fruit; I, stellate hair; J, leafy shoot with male inflorescence; K, longitudinal section of male flower; L, stellate hair; M, leafy shoot with mature fruit; N, leafy shoot with young fruit. (A–C from SAN 64604, D–F from SAN 53434, G from SAN 91695, H–I from S 27851, J–L from S 21330, M from S 39858, N from S 51427.)

CLTS (1980) 248; Pannell *op. cit.* (1982) 455, *op. cit.* (1989) 219, *op. cit.* (1992) 70, *op. cit.* (1995) 216; Whitmore, Tantra & Sutisna *op. cit.* 223; PROSEA *op. cit.* (1995) 49; Turner *op. cit.* 337.

Basionym: *Amoora malaccensis* Ridl., J. Str. Br. Roy. As. Soc. 75 (1917) 16, *op. cit.* (1922) 399.

Lectotype (Pannell, 1982): Ridley 1797, Peninsular Malaysia, Malacca, Ayer Panas (K).

Tree to 25 m tall, to 60 cm diameter, branched; sometimes with a few thick, shallow buttresses to 50 cm tall. **Bark** greyish brown or yellowish brown, with longitudinal rows of lenticels, flaking in large scales of irregular size to 65 × 35 cm; inner bark pink or white; latex white. **Sapwood** pink, yellow or white. **Twigs** fairly stout, *apices densely covered with small pale brown or almost white stellate hairs or scales*. **Leaves** imparipinnate, to 50 cm long; petioles to 20 cm long; *leaflets smooth on both surfaces, (dull) green above and dark purplish brown below when dry, with a few very small pale brown stellate scales on the lower surface; lateral leaflets 4–7 on each side of rachis, subopposite; blades lanceolate, oblong or elliptical, 6.5–19 × 2–6.5 cm, base rounded, asymmetrical, margin planar, apex acuminate, acumen obtuse or acute, to 15 mm long; midrib impressed above, prominent below, sparsely to densely covered with minute dark reddish brown peltate scales; lateral veins 10–14 on each side of midrib, impressed above, slightly or not at all prominent below; intercostal venation faint; petiolules 1.5–2 cm long*. **Inflorescences** to 25 cm long, to 15 cm wide, densely covered with indumentum like that of the twigs. **Flowers** obovoid, to 3 × 2.5 mm; *calyx divided to about halfway into 3 (or rarely 4) acute lobes, outside densely covered with stellate scales; petals 3, white, obovate, outside densely covered with stellate scales; staminal tube obovoid, cup-shaped, c. 2 mm tall, anthers 6 (or rarely 7), as long as the staminal tube, narrowly ellipsoid; ovary depressed globose, densely covered with stellate hairs, stigma ovoid with 3 apical lobes and 6 longitudinal ridges*. **Fruits** depressed globose, 3.8–6 × 5.3–7 cm, reddish brown, *dehiscing into 3 lobes when ripe, locules 3 or 4, each containing 0 or 1 seed; latex white*. **Seeds** 2.7–3.8 × 2–2.1 × 1.5–1.8 cm, completely covered with a red or yellow aril 1–2 mm thick.

Distribution. Sumatra, Peninsular Malaysia, Borneo and the Philippines. In Sabah, recorded from Keningau, Kinabatangan, Labuk Sugut and Sipitang districts (e.g., SAN 72126, SAN 76287, SAN 83361, SAN 84130 and SAN 84833) and in Sarawak from Belaga, Bintulu, Kuching and Lundu districts (e.g., S 13951, S 18303, S 57161 and S 81378). Also occurring in Kalimantan (e.g., Arbainsyah *et al.* AA 1985 and Leighton 859) but not yet recorded from Brunei.

Ecology. In mixed dipterocarp forests on clay, shale, sandy and loamy soils, at altitudes to 700 m. Rare and scattered to common.

31. *Aglaia meliosmoides* Craib (like *Meliosma*, Sabiaceae; the leaves)

Fig. 7A–G, Plate 3D.

Sect. *Aglaia*

Bull. Misc. Inform. Kew (1913) 68; Corner *op. cit.* (1978) 31; Pannell *op. cit.* (1989) 219; Whitmore, Tantra & Sutisna *op. cit.* 223; Beaman & Anderson *op. cit.* 122. **Lectotype** (Pannell, 1992): Kerr 2369, Thailand, Rawng Kwang (K; isoelectotypes BM, E, K). **Synonyms:** *Aglaia matthewsii* Merr. *op. cit.* (1918) 79, *op. cit.* (1921) 322, *op. cit.* (1929) 124, Masamune *op. cit.* 372, Anderson *op. cit.* (1980) 248; *Aglaia unifoliolata* auct. non Koord. (1898): Ridley *op. cit.* (1930) 369, Anderson *op. cit.* (1980) 249; *Aglaia triandra* Ridl. *op. cit.* (1938) 215, *nom. nov. pro Aglaia unifoliolata* Ridl.; *Aglaia odoardo* Merr., Webbia 7 (1950) 312, Anderson *op. cit.* (1980) 249; *Aglaia shawiana* Merr. *op. cit.* (1950) 314, Anderson *op. cit.* (1980) 249.

Tree to 20 m tall, to 30 cm diameter, branched; sometimes flowering when *c.* 1.5 m tall. **Bark** greyish brown, yellowish brown, pale or dark brown, pale yellow, usually smooth, sometimes lenticellate or flaky; inner bark brown, reddish brown, blackish red, pink, pale orange; latex white. **Sapwood** white, pale yellow or pink. **Twig apices densely covered with orange-brown or reddish brown stellate hairs, sometimes interspersed with peltate scales, sparsely so elsewhere.** **Leaves simple**, glossy green above and paler green below, *upper surface shiny when dry; blades elliptical or lanceolate-oblong, 4.8–29 × 1.5–8 cm*, base cuneate, slightly asymmetrical, margin slightly recurved and somewhat wavy, apex acute to acuminate, acumen to 25 mm long; midrib prominent on both surfaces, sometimes with persistent indumentum like that of the twigs; lateral veins 7–20 on each side of midrib, prominent below, subprominent above, with persistent indumentum similar to that of the twigs; *intercostal venation subprominent on both surfaces when dry*; young leaves densely covered with hairs like that of the twigs, glabrescent, sometimes persisting on the midrib near the petiole on both surfaces; petioles to 4 cm long, with swelling to 0.5 cm long adjacent to the lamina. **Inflorescences** to 20 cm long and 15 cm wide, densely covered with hairs like that of the twigs. **Flowers** subglobose, 1.9–2 × 1.7 mm, either sessile or with a pedicel to 2 mm long; *calyx deeply divided into 5 subrotund lobes; petals 5*; staminal tube *c.* 1.5 × 1.1 mm, anthers about half the length of staminal tube; ovary subglobose, stigma *c.* 0.4 × 0.1 mm. **Fruits indehiscent, locules 1 or 2**, each containing 1 seed, *without a longitudinal ridge around it*, obovoid or subglobose, either to 4.4 × 4.1 cm, yellow or white, with a thick woody pericarp to 10 mm thick and densely covered with stellate hairs on the outside, glabrescent, or *c.* 3.5 × 3 cm with pericarp *c.* 1 mm thick.

Vernacular name. Sarawak—*segera* (Iban).

Distribution. Thailand, Sumatra, Peninsular Malaysia, Singapore and Borneo. Common; in Sabah, known from Beaufort, Keningau, Kinabatangan, Kota Merudu, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Sipitang and Tawau districts (e.g., *SAN 36081*, *SAN 66283*, *SAN 68101*, *SAN 71258* and *SAN 79953*) and in Sarawak from Bintulu, Kapit, Kuching and Miri districts (e.g., *S 16575*, *S 18348*, *S 24302*, *S 37461* and *S 48402*). Also occurring in Brunei (e.g., *BRUN 87*, *Nielsen & Baslev 1104* and *Simpson 2354*) and Kalimantan (e.g., *Ambriansyah & Arifin B 1496*, *Burley et al. 2872*, *Nooteboom 4420* and *Wilkie 94176*).

Ecology. In mixed dipterocarp and *kerangas* forests, often on hillsides, on clay-rich soil or yellow sandy soil, sometimes on limestone or granite, at altitudes to 1350 m.

Notes. Pannell (*op. cit.* 1992 & *op. cit.* 1995) treated this species as a synonym of *Aglaia simplicifolia*. In the present treatment, however, the species is recognised as distinct, differing from *A. simplicifolia* in its leaves which are shiny above when dry, subprominent intercostal venation on both surfaces, and fruit without a longitudinal ridge around it.

32. *Aglaia monozyga* Harms

(Greek, *monos* = solitary, *zygos* = yoke; the leaf with one lateral leaflet on each side of rachis)

Sect. *Aglaia*

Notizbl. Bot. Gart. Berlin 15 (1941) 473; Anderson *op. cit.* (1980) 249; Whitmore, Tantra & Sutisna *op. cit.* 223; Pannell *op. cit.* (1992) 311, *op. cit.* (1995) 299; Turner *op. cit.* 337; Beaman & Anderson

op. cit. 122. **Lectotype** (Pannell, 1992): *Clemens 28192*, Borneo, Sabah, Mt. Kinabalu, Tenompok (K; isoelectotypes B, BO, G, K, L).

Small tree to 10 m tall, to 16 cm diameter, branched. **Bark** smooth, white; inner bark reddish brown or yellowish brown. **Twigs** longitudinally wrinkled, *apices densely covered with reddish brown stellate hairs which are often deciduous*. **Leaves** imparipinnate, 8–67 cm long; petioles 2.5–10(–14.5) cm long; *leaflets coriaceous, rugulose and minutely pitted on both surfaces, pale green or yellowish green when dry, both surfaces densely covered with hairs like that of the twigs when young, becoming more or less glabrous when older; lateral leaflets 1 or 2 on each side of rachis, opposite; blades lanceolate or obovate, 8–25(–46) × 3–7(–13) cm, base cuneate or attenuate, sometimes asymmetrical and rounded on one side, margin recurved, apex acuminate or caudate, acumen acute or obtuse, to 20 mm long; midrib prominent or subprominent on both surfaces; lateral veins 6–15(–23) on each side of midrib, subprominent or barely prominent on both surfaces, black or dark brown when dry; intercostal venation faint on both surfaces; petiolules 1–3.5(–4) cm long, swollen at the base, flat or channelled on the adaxial side*. **Inflorescences** robust, 11–35 cm long, 7–12 cm wide, *densely covered with reddish brown or pale reddish brown stellate hairs*. **Flowers** 1.2–3 × 1.5–2.5 mm; *calyx divided into 5 subrotund lobes, outside densely covered with reddish brown stellate hairs; petals 5; staminal tube cup-shaped or broadly cone-shaped, 0.5–1.5 × 1.5 mm, anthers 5, 0.5–0.7 mm long; ovary depressed globose, 0.2–0.3 mm long, densely covered with pale brown stellate hairs with long arms, locules 1 or 2, stigma 0.3–0.4 mm long, ovoid, subglobose or depressed globose with a shallowly lobed margin and central depression*. **Fruits** indehiscent, *locules 2, each with 0 or 1 seed, subglobose or ellipsoid, to 4.5 × 4.1 cm, sometimes with a longitudinal ridge around it or with a small beak; pericarp 0.4–0.9 cm thick, orange or orange-red*. **Seeds** *c.* 3.1 × 2.1 × 1.8 cm; aril pink.

Vernacular names. Sabah—*beluno-beluno* (Dusun), *langsar-langsar* (Malay).

Distribution. Peninsular Malaysia and Borneo. In Sabah, known from Keningau, Labuk Sugut, Ranau, Sandakan, Tambunan and Tawau districts (e.g., *Clemens 30181*, *SAN 71929*, *SAN 81372*, *SAN 94961* and *SAN 111316*) and in Sarawak from Belaga, Kapit and Sri Aman districts (e.g., *S 25749*, *S 42525*, *S 56588* and *S 82180*). Also occurring in E Kalimantan (e.g., *Burley et al. 324*, *Burley et al. 792* and *Kostermans 10441*) but not yet recorded from Brunei.

Ecology. In mixed dipterocarp, riverine, freshwater swamp, and montane forests on sandy, loam, laterite, and clay soils, sometimes on limestone, at altitudes to 2000 m.

33. *Aglaia multinervis* Pannell

(Latin, *multus* = many, *nervus* = nerve; the many-veined leaflets)

Sect. **Amoora**

Kew Bull. Add. Ser. 16 (1992) 84, *op. cit.* (1995) 222; PROSEA *op. cit.* (1995) 49; Turner *op. cit.* 338. **Lectotype** (Pannell, 1992): *Maingay 1610* (= *Kew Distr. 343*), Peninsular Malaysia, Malacca (K). **Synonym:** *Amoora lanceolata* Hiern *op. cit.* 560, King *op. cit.* 55, Ridley *op. cit.* (1922) 399; *Aglaia* sp. 3, Pannell *op. cit.* (1989) 228; *Aglaia* sp. 3/C, Whitmore, Tantra & Sutisna *op. cit.* 226.

Tree to 25 m tall, to 30 cm diameter, branched; buttresses small. **Bark** pale brown or pale; inner bark reddish brown; latex white. **Sapwood** pink, pale yellow. **Twigs** stout, *apices densely covered with peltate scales with a dark reddish brown centre and pale fimbriate margin, sometimes interspersed with reddish brown stellate hairs*. **Leaves** imparipinnate, to 40 cm long; petioles to 10 cm long; *leaflets coriaceous, lower surface rugulose, with a few pale brown stellate scales with a darker centre on the midrib and scattered elsewhere; lateral leaflets 10–12 on each side of rachis, subopposite, terminal ones not folded at the base; blades lanceolate, 7–12 × 1.8–2 cm, base rounded or subcuneate, slightly asymmetrical, margin planar, apex acuminate, acumen obtuse, to 5 mm long; midrib slightly impressed above, prominent and wrinkled below; lateral veins 20–25 on each side of midrib, alternating with less conspicuous veins which sometimes branch before reaching the margin, indistinct below, rarely turning black when dry; intercostal venation sometimes visible; petiolules to 1 cm long, sparsely stellate hairy*. **Inflorescences** c. 20 cm long, c. 10 cm wide, densely covered with peltate fimbriate scales like that of the twigs. **Flowers** 2.3–3 × 1.8–2.8 mm; *calyx c. half the length of corolla, divided halfway into 3 acute lobes, outside densely covered with stellate scales; corolla tube 2.2–3 × 1.8 × 2.8 mm, divided for two thirds of its length into 3 lobes, outside densely covered with stellate scales; staminal tube obovoid, 1.5–2 × 0.8–2.3 mm, anthers 6 or 7, ellipsoid, 1.2–1.5 × 0.3–0.6 mm, with a few simple hairs; ovary depressed globose, 0.4–0.6 × 0.6–0.8 mm, stigma ovoid with 3 apical lobes and 6 longitudinal ridges, 0.4–0.8 × 0.3–0.5 mm*. **Fruits** subglobose or obovoid with a small beak, to 6 × 5 cm, brown, bright red or yellow, densely covered with minute reddish brown stellate hairs; *dehiscing into 3 lobes when ripe, locules 3, each containing one seed*.

Vernacular names. Sabah—*langsats-langsats* (Malay), *lantupak* (Dusun Kinabatangan), *manggi* (Dusun Kinabatangan).

Distribution. Sumatra, Peninsular Malaysia, Singapore and Borneo. In Sabah, known from Keningau, Kinabatangan, Lahad Datu, Sandakan and Tawau districts (e.g., *SAN 16438*, *SAN 19222*, *SAN 42152*, *SAN 85005* and *SAN 88689*) and in Sarawak from Lubok Antu and Marudi districts (e.g., *S 69606*, *S 91409* and *S 91580*). Also occurring in E Kalimantan (e.g., *Kostermans 5067*, *Kostermans 5867*, *Kostermans 6702* and *Kostermans 12635*) but not yet recorded from Brunei.

Ecology. In forest, often on hillsides, at altitudes to 500 m.

Notes. The older epithet *lanceolata* can not be applied to this species because it has been preoccupied by *Aglaia lanceolata* Merr. (Philip. J. Sc., Bot. 5 (1910) 184, which has become a synonym of *A. rimosa* (Blanco) Merr., Spec. Blanc. (1918) 212).

34. *Aglaia neotenica* Kosterm.

Fig. 7H–I.

(Greek, *neos*- = new or young, *teinein* = extend or retain; retaining juvenile form, the fruit)

Sect. *Aglaia*

Reinwardtia 7, 5 (1969) 433. **Type:** *Hallier 2810*, Borneo, Kalimantan, Lianggagang (holotype BO; isotypes K, L).

Small tree to 8 m tall, branched. **Bark** smooth, greyish green. **Twigs** pale greenish brown or greyish brown, *densely covered with deciduous reddish brown stellate hairs*. **Leaves** simple,

with dense hairs like that of the twigs when young, glabrous or with few hairs on the midrib below when older, *pale green when dry*; *blades narrowly elliptical*, sometimes elliptical, (5–)10–15(–24) × (1.5–)2–4 cm, *base cuneate*, margin planar, *apex caudate*, *acumen narrow, obtuse, to 22 mm long*; midrib impressed above, prominent below; *lateral veins 8–15 on each side of midrib*, ascending, curved upwards near the margin and nearly or quite anastomosing, impressed above, subprominent below; *intercostal venation slightly prominent below*; petioles 0.5–2 cm long. **Inflorescences** to 3.5 cm long and 2.5 cm wide. **Flowers** 2–2.5 × 2–2.5 mm; calyx cup-shaped, divided almost to the base into 5 ovate lobes *c.* 1.5 × 1 mm; *petals 5, aestivation quincuncial*; staminal tube shallowly cup-shaped, 1.2 × 1.6 mm, anthers 3; ovary 0.2 × 0.3 mm, with dense orange-brown stellate hairs, stigma sessile, *c.* 0.6 × 0.3 mm. **Fruits indehiscent**, borne singly, *ovoid, to 6.9 × 3.9 cm*, green turning bright reddish orange when ripe, *with up to 8 shallow longitudinal ridges or prominent flanges to 3 mm wide*, sometimes with a small apical beak to 3 mm long, densely covered with brown stellate hairs; peduncles to 1.5 cm long. **Seed** 1.

Vernacular name. Sarawak—*segera* (Iban).

Distribution. Endemic in Borneo, known only in Sarawak from Bau, Bintulu, Kapit, Kuching, Marudi and Miri districts (e.g., *S* 17632, *S* 23038, *S* 25638, *S* 30758, *S* 43883 and *S* 66003) and in Kalimantan from the type.

Ecology. In mixed dipterocarp forest or forest on slopes, usually on limestone, sometimes on clay loam or rhyodacite-derived soil, at altitudes to 900 m.

Notes. Previously treated by Pannell (*op. cit.* 1992 & *op. cit.* 1995) as a synonym of *Aglaia simplicifolia*, *A. neotenica* is here recognised as distinct, differing from *A. simplicifolia* in its narrowly elliptical leaves and fruit with 8 or more longitudinal ridges or flanges.

35. *Aglaia odoratissima* Blume

(Latin, *odoratissimus* = very sweet-smelling; the flowers)

Sect. *Aglaia*

Bidjr. Fl. Ned. Ind. (1825) 171; Miquel *op. cit.* (1868) 43; King *op. cit.* 67; Koorders & Valetton *op. cit.* (1913) t. 160; Ridley *op. cit.* (1922) 404; Merrill *op. cit.* (1929) 124; Masamune *op. cit.* 372; Backer & Bakhuizen *f. op. cit.* 128; Corner *op. cit.* (1978) 31, *op. cit.* (1988) 496; Anderson *op. cit.* (1980) 249; Pannell *op. cit.* (1989) 221, *op. cit.* (1992) 237, *op. cit.* (1995) 276; Whitmore, Tantra & Sutisna *op. cit.* 224; Turner *op. cit.* 338; Coode *et al.* (eds.) *op. cit.* 201; Beaman & Anderson *op. cit.* 122. **Lectotype** (Pannell, 1992): *Blume s.n.*, Java, Mt. Salak (L [Acc. No. 9081321428]; isoelectotypes BO, L [Acc. No. 9081321458, 9081321495 & 9081321499]). **Synonyms:** *Aglaia affinis* Merr. *op. cit.* (1908) 235, Masamune *op. cit.* 370, Anderson *op. cit.* (1980) 247; *Aglaia heterophylla* Merr. *op. cit.* (1918) 77, *op. cit.* (1921) 322, Masamune *op. cit.* 371; *Aglaia cuspidella* Ridl. *op. cit.* (1930) 367, Anderson *op. cit.* (1980) 247. (For further synonyms cf. Pannell *op. cit.* 1992 & *op. cit.* 1995.)

Usually a small tree, sometimes to 18 m tall, to 25 cm diameter, branched. **Bark** smooth, greenish grey, pale brown or brown, with small lenticels in longitudinal rows; inner bark reddish brown, yellow or white; latex white. **Sapwood** pale yellowish brown or pale yellow; heartwood reddish brown. **Twig apices densely covered with dark brown, peltate fimbriate scales (usually less than 0.2 mm diameter) interspersed with pale yellowish brown stellate**

hairs. Leaves imparipinnate, to 40 cm long; petioles to 6.5 cm long; *leaflets often bluish green above and pale brown below when dry, the midrib above sparsely covered with scales or hairs like that of the twigs, densely so on the midrib below, and sparsely to densely so on the lower surface; lateral leaflets 1 or 2 (or rarely 3) on each side of rachis*, subopposite or opposite; *blades elliptical, ovate or obovate*, (2.2–)5–18 × (0.7–)1.5–7.5 cm, base rounded or cuneate, asymmetrical, margin slightly recurved, apex acuminate-caudate, acumens obtuse, to 20 mm long; midrib prominent below; lateral veins (rarely 4) 5–11 on each side of midrib, subprominent below; intercostal venation faint on both surfaces; *petiolules 2–3.5 cm long. Inflorescences* densely covered with reddish brown stellate scales; males 7–35 cm long, 2–25 cm wide, females 3.5–12 cm long. **Flowers** 1.1–1.5 × 1–1.5 mm; *calyx* outside with numerous reddish brown stellate scales, *divided almost to the base into 5 subrotund lobes; petals 5*; staminal tube shallowly cup-shaped, 0.8–1 × 0.9–1.4 mm, apical margin incurved and shallowly 5-lobed, anthers ovoid, *c.* 0.3 × *c.* 0.2 mm; ovary depressed globose, 0.2–0.3 mm across, densely covered with stellate hairs, locules 1 or 2, each containing 1 ovule, stigma ovoid, *c.* 0.3 × 0.4 mm. **Fruits indehiscent, locules 1 (rarely 2)**, each containing 1 seed, ellipsoid or obovoid, 1.5–2 × 1–1.6 cm, yellow, orange or orange-red, densely covered with pinkish orange stellate scales turning brown when dry; pericarp 1–1.5 mm thick, fibrous and flexible. **Seeds** 1.3–1.4 × 0.9–1.1 × 0.7–0.8 cm; aril 1 mm thick, pale pink, white or yellow, translucent, gelatinous, sweet-tasting.

Vernacular names. Sabah—*langsats* (Malay), *langsats munyit* (Malay), *lantupak* (Dusun Kinabatangan), *tanggal* (Dusun Kinabatangan). Sarawak—*segera* (Iban).

Distribution. Nicobar Islands, Myanmar, Thailand, Sumatra, Peninsular Malaysia, Borneo, the Philippines, Java, Nusa Tenggara and Sulawesi. Common throughout Sabah and Sarawak. In Sabah, known from Beaufort, Keningau, Kinabatangan, Kota Kinabalu, Kudat, Lahad Datu, Ranau, Sandakan, Semporna and Tawau districts (e.g., *SAN 57190*, *SAN 67184*, *SAN 76477*, *SAN 82258* and *SAN 116612*) and in Sarawak from Bau, Belaga, Kapit, Kuching, Lawas, Lundu, Miri, Serian, Simunjan and Tatau districts (e.g., *S 18454*, *S 21728*, *S 34208*, *S 44684* and *S 55293*). Also occurring in Brunei (e.g., *Argent 9198*, *Dransfield JD 6811*, *Kirkup DK 344*, *Niga NN 360* and *Wong WKM 1396*) and Kalimantan (e.g., *Church et al. 1198*, *Endert 4945*, *Kessler et al. PK 1347* and *Sidiyasa 1207*).

Ecology. In mixed dipterocarp and riverine forests, on clay loam, basalt, shale-derived, brown sandy, and yellow or white sandy soils, at altitudes to 1370 m.

36. *Aglaia oligophylla* Miq.

(Greek, *oligos* = few, *phullon* = leaf; with few leaflets)

Sect. *Aglaia*

Fl. Ind. Bat. Suppl. 1 (1861) 507, *op. cit.* (1868) 41; King *op. cit.* 63; Ridley *op. cit.* (1922) 403; Pannell *op. cit.* (1989) 222, *op. cit.* (1992) 302, *op. cit.* (1995) 297; Whitmore, Tantra & Sutisna *op. cit.* 224; Turner *op. cit.* 338; Beaman & Anderson *op. cit.* 123. **Lectotype** (Pannell, 1992): *Diepenhorst s.n.*, Sumatra, Priaman (U [Acc. No. 39229]; isoelectotype U [Acc. No. 39230]). **Synonyms:** *Aglaia oligantha* C.DC. *op. cit.* (1878) 603, Merrill *op. cit.* (1929) 124, Masamune *op. cit.* 372; *Aglaia fusca* King *op. cit.* 62, Pannell *op. cit.* (1989) 216; *Aglaia bordenii* Merr. *op. cit.* (1904) 22; *Aglaia polyantha* Ridl. *op. cit.* (1930) 369, Anderson *op. cit.* (1980) 249; *Aphanamixis reticulosa* Kosterm., Reinwardtia 7, 1 (1965) 30.

Tree to 25 m tall, to 25 cm diameter, branched. **Bark** smooth, pale green, pale brown, greenish yellow or pale grey; inner bark pale green, pale grey, pale yellow or yellowish brown; latex white. **Sapwood** white or yellow. **Twig** apices densely covered with pale yellowish brown stellate hairs or scales. **Leaves** imparipinnate, to 40 cm long; petioles to 9 cm long; leaflets subcoriaceous, both surfaces rather shiny when dry, lower surface with a few to dense pale brown stellate hairs on the midrib and occasionally also on the rest of the surface; lateral leaflets 1–5 on each side of rachis, opposite or subopposite, basal ones only slightly smaller than the rest; blades obovate or elliptical, 5–22 × 2–8.5 cm, base cuneate or rounded, asymmetrical, margin recurved, apex acuminate-caudate, acumen obtuse, to 10 mm long; midrib prominent below; lateral veins 5–10 on each side of midrib, subprominent on both surfaces; intercostal venation visible above, subprominent below; petiolules 1.2–2 cm long, thickened at base, densely covered with indumentum like that of the twigs. **Inflorescences** 10–20 cm long, 9–15 cm wide, densely covered with indumentum like that of the twigs. **Flowers** depressed globose, to 2 × 2.5 mm; calyx divided to almost halfway into 5 blunt lobes with ciliate margin, outside sparsely covered with stellate scales; petals 5; staminal tube depressed globose, c. 1 × 1.3 mm, anthers 5, obovoid, c. 0.5 mm; ovary depressed globose, stigma narrowly ovoid, densely covered with stellate hairs on the lower two thirds, with two small shiny black glabrous apical lobes. **Fruits** indehiscent, locules 1 or 2 (rarely 3), each containing 1 seed, subglobose, to 3.4 × 3.7 cm; pericarp greyish brown or yellow, woody and longitudinally ridged when dry, outside densely covered with pale yellowish brown stellate hairs. **Seeds** with a translucent gelatinous, white or brown, sweet edible aril.

Vernacular names. Sabah—*langsar-langsar* (Malay), *langsar munyit* (Malay), *lantupak* (Dusun Kinabatangan). Sarawak—*segera* (Iban).

Distribution. Andaman Islands, Thailand, Sumatra, Peninsular Malaysia, Borneo and the Philippines. In Sabah, known from Kinabatangan, Lahad Datu, Ranau, Sandakan, Semporna, Tawau and Tenom districts (e.g., SAN 24030, SAN 65875, SAN 77941, SAN 89501 and SAN 93137) and in Sarawak from Kapit, Kuching and Limbang districts (e.g., Haviland 3200, S 42943, S 47362, S 62005 and S 85897). Also occurring in Brunei (e.g., Simpson 2150) and Kalimantan (e.g., Church *et al.* 2401, Kostermans 4847, Kostermans 10168 and Kostermans 21043).

Ecology. In mixed dipterocarp and *kerangas* forests, at altitudes to 830 m.

37. *Aglaia pachyphylla* Miq.

(Greek, *pachys* = thick, stout, *phullon* = leaf)

Sect. *Aglaia*

Ann. Mus. Bot. Lugd. Bat. 4 (1868) 57; Pannell *op. cit.* (1992) 117, *op. cit.* (1995) 234; PROSEA *op. cit.* (1995) 50; Turner *op. cit.* 338; Argent *et al.* (eds.) *op. cit.* 412; Beaman & Anderson *op. cit.* 123. **Lectotype** (Pannell, 1992); Korthals *s.n.*, W Sumatra (U [Acc. No. 39214]; isoelectotype L [Acc. No. 9081321571 & 9081321650]). **Synonyms:** *Aglaia barbatula* Koord. & Valetton *op. cit.* (1896) 167, *op. cit.* (1913) t. 153, Backer & Bakhuizen *f. op. cit.* 126, Pannell *op. cit.* (1989) 213, Whitmore, Tantra & Sutisna *op. cit.* 220; *Aglaia megistocarpa* Merr. *op. cit.* (1929) 130, Masamune *op. cit.* 372, Anderson *op. cit.* (1980) 248.

Tree to 43 m tall, to 65 cm diameter, branched; sometimes flowering when *c.* 3 m tall; buttresses to 2 m tall, to 1 m out and to 23 cm thick. **Bark** brown, greyish brown, with large corky lenticels or with pits and regular longitudinal narrow fissures; inner bark dark brown or yellow; latex white, when present. **Sapwood** pinkish brown, pale brown. **Twigs** to 3 cm diameter, with large prominent petiole scars, *channelled, densely covered with reddish brown stellate hairs or hairs with a long central rachis and many arms*. **Leaves** *imparipinnate*, to 135 cm long; petioles to 30 cm long; *leaflets smooth on both surfaces, upper surface usually shiny*, with numerous minute pits, *lower surface densely covered with pale reddish brown hairs with a central rachis and 2–4 whorls of arms radiating from it or densely covered with pale or dark brown stellate hairs or scales, sometimes interspersed with darker hairs*; lateral leaflets 9–13 on each side of rachis, subopposite; *blades oblong, lanceolate or oblanceolate, 12–31.5 × 2–9 cm*, base rounded, subcordate or cuneate, asymmetrical, margin planar, apex acuminate, acumen acute or obtuse, to 15 mm long; midrib impressed above, prominent below; *lateral veins 24–39 on each side of midrib*, impressed above, prominent below; *intercostal venation subprominent or faint but visible on both surfaces*; *petiolules 1–2.5 cm long*. **Inflorescences** to 45 cm long, to 60 cm wide, densely covered with hairs like that of the twigs. **Flowers** sessile on the terminal branches of the inflorescence and often clumped together, subglobose, to 2.2 × 2 mm; *calyx* almost as long as corolla, outside densely covered with pale brown stellate hairs, *with 5 rounded lobes*; *petals 5, c. 1.3 × 1.7 mm*; staminal tube subglobose, *c. 1.1 × 1.3 mm*, thick and fleshy, anthers 0.8 × 0.5–0.6 mm; ovary depressed globose, *c. 0.4 × 0.7 mm*, locules 3, each containing 2 ovules, stigma cylindrical, *c. 0.6 × 0.3 mm*, truncate at the apex. **Infructescences** with 1–3 fruits each, crowded in axils of leaves at ends of shoots. **Fruits** *indehiscent, locules 2 or 3 (rarely 4)*, each containing 1 or 2 seeds, obovoid or subglobose, *to 8 × 8.5 cm*, greyish green when young, brown when mature, *glabrescent*; pericarp 1.6–2 cm thick, with white latex. **Seeds** *c. 3.6 × 2.1 × 1.9 cm*, completely surrounded by a fleshy, translucent aril.

Vernacular names. Sabah—*koping-koping* (Malay), *langsar-langsar* (Malay).

Distribution. Thailand, Sumatra, Peninsular Malaysia, Borneo, the Philippines, Java and Sulawesi. In Sabah, recorded from Keningau, Kinabatangan, Labuk Sugut, Lahad Datu, Sandakan and Semporna districts (e.g., *SAN 29818*, *SAN 82351*, *SAN 92156* and *S 94021*) and in Sarawak from Kapit, Kuching, Lawas, Lundu and Miri districts (e.g., *S 13643*, *S 20892*, *S 28289*, *S 31545* and *S 41873*). Also occurring in Kalimantan (e.g., *Burley et al. 692* and *Burley et al. 2706*) but not yet recorded from Brunei.

Ecology. In forest, on limestone, igneous rocks, clay and sandstone, at altitudes to 600 m.

38. *Aglaia palembanica* Miq. (of Palembang, Sumatra)

Sect. *Aglaia*

Fl. Ind. Bat. Suppl. 1 (1861) 507, *op. cit.* (1868) 52; Hiern *op. cit.* 557; King *op. cit.* 72, *p.p.*; Merrill *op. cit.* (1921) 323, *op. cit.* (1929) 124; Ridley *op. cit.* (1922) 409, *p.p.*; Masamune *op. cit.* 372; Corner *op. cit.* (1978) 131; Anderson *op. cit.* (1980) 249; Pannell *op. cit.* (1989) 223, *op. cit.* (1992) 323, *op. cit.* (1995) 304; Whitmore, Tantra & Sutisna *op. cit.* 224; Turner *op. cit.* 338; Beaman & Anderson *op. cit.* 123. **Lectotype** (Pannell, 1992): *Teysmann HB 3527*, Sumatra, Palembang, Batu

Radja (U [Acc. No. 39222]; isoelectotypes K, L [Acc. No. 9081321647]). **Synonym:** *Aglaia pamattonis* Miq. *op. cit.* (1868) 53, Merrill *op. cit.* (1921) 323, Masamune *op. cit.* 372.

Treelet to 5 m tall, branched. **Twig** apices densely covered with brown stellate hairs with the arms usually not overlapping. **Leaves** imparipinnate, to 36 cm long; petioles to 10 cm long; leaflets below with brown stellate hairs like that of the twigs evenly scattered, interspersed with some paler stellate scales or peltate scales with a long fimbriate margin; lateral leaflets 4–6 on each side of rachis, subopposite; blades narrowly elliptical, lanceolate, oblong or oblanceolate, 6–22.5 × 1.3–3.5 cm, base cuneate or rounded, asymmetrical, margin slightly wavy and recurved, apex caudate or acuminate, acumen obtuse or acute, to 15 mm long; midrib prominent below; lateral veins 9–13 on each side of midrib, subprominent below; *intercostal venation faint but visible below*; petiolules to 0.8 cm long. **Inflorescences** to 30 cm long and 30 cm wide, densely covered with brown stellate hairs. **Flowers** tightly packed on the terminal branches of the inflorescence, subglobose or slightly longer than broad, c. 1.2 mm long; *calyx* c. 1.2 mm diameter, with 5 rotund or elliptical obtuse lobes, outside sparsely to densely covered with pale brown stellate hairs; *petals* 5; staminal tube c. 0.8 mm tall, cup-shaped with the apical margin incurved, anthers ovoid c. 0.4 mm long; ovary depressed globose. **Fruits** indehiscent, *locules* 1 or 2, subglobose, to 4 mm diameter, glabrous or sparsely hairy, brown or red; pericarp thin and brittle.

Vernacular name. Sabah—*lantupak* (Dusun Kinabatangan).

Distribution. Sumatra, Peninsular Malaysia, Borneo and the Philippines. In Borneo, known only in Sabah from Keningau, Kinabatangan, Kota Belud, Kudat, Labuk Sugut, Lahad Datu, Sandakan, Tawau and Tenom districts (e.g., SAN 43030, SAN 55846, SAN 63271, SAN 72022 and SAN 88198) and in Kalimantan (e.g., Arifin *et al.* AA 1141, Laman *et al.* TL 1240 and Motley *s.n.*).

Ecology. In forest, on clay, laterite, sandstone, sand, limestone-derived soils, at altitudes to 450 m.

39. *Aglaia ramotricha* Pannell

(Latin, *ramus* = branch, Greek, *trichos* = hair; with branched hairs)

Sect. *Aglaia*

Kew Bull. Add. Ser. 16 (1992) 115, *op. cit.* (1995) 234; Beaman & Anderson *op. cit.* 123. **Type:** Beaman 9308, Borneo, Sabah, Kota Belud district (holotype FHO; isotype K).

Tree, 6–15(–20) m tall, to 20 cm diameter, branched; buttresses to 60 cm tall, to 30 cm out. **Bark** brown; inner bark pale brown or pink. **Sapwood** yellow or brown. **Twigs** 2–4.2 cm diameter, densely covered with compact reddish brown stellate hairs or brown hairs which have a central rachis and 2–4 whorls of arms radiating from it. **Leaves** imparipinnate, to 155 cm long; petioles to 46 cm long; leaflets below with numerous hairs like that of the twigs when young, with numerous reddish brown, pale brown or nearly white stellate hairs and scales on the midrib and lateral veins and sparsely so on the rest of that surface when mature; lateral leaflets 7–10 on each side of rachis, subopposite or alternate; blades oblong

or elliptical, $8.5\text{--}68 \times 3\text{--}22$ cm, base rounded, subcordate or cuneate, margin recurved, apex broadly acuminate, acumen obtuse or acute, 5–20 mm long; midrib prominent below; lateral veins 16–32 on each side of midrib, subprominent below; *intercostal venation subprominent on both surfaces*; petiolules 1–2.5 cm long. **Inflorescences** to 45 cm long, to 60 cm wide, sparsely branched, densely covered with hairs like that of the twigs or the distal branches densely covered with golden-brown stellate hairs. **Flowers** ellipsoid or subglobose, $1.6\text{--}3.5 \times 1.6\text{--}2.5$ mm, sessile and clumped around the terminal branches of the inflorescence; *calyx* almost as long as corolla, with 5 rounded lobes, outside sparsely covered with pale brown stellate scales; *corolla* $1.3\text{--}3 \times 1.4\text{--}2.5$ mm, divided to half way or almost to the base into 5 broad ovate lobes; staminal tube ellipsoid or obovoid, $1\text{--}2.5 \times 1.1\text{--}1.8$ mm, anthers 5, ellipsoid or ovoid, $0.7\text{--}1.2 \times 0.5\text{--}0.8$ mm; ovary depressed globose, $0.1\text{--}0.5 \times 0.6\text{--}0.7$ mm, densely covered with pale stellate scales or hairs, locules 2 or 3, stigma $0.5\text{--}1.1 \times 0.3\text{--}0.5$ mm, apex expanded to 0.4–0.5 mm wide, columnar, shiny dark brown, with 5–10 longitudinal ribs and 3–5 apical lobes. **Fruits** indehiscent, locules 2 or 3, each containing 1 seed, reddish yellow, subglobose or ellipsoid, c. 3.5 cm diameter, with numerous to densely packed compact reddish brown hairs or pale brown stellate hairs. **Seeds** to 2×1.2 cm.

Vernacular name. Sabah—*lantupak* (Dusun Kinabatangan).

Distribution. Endemic in Borneo, known only in Sabah from Kuala Penyu and Ranau districts (e.g., Beaman 9722, Clemens 26870 and Clemens 31468), in Sarawak from Bau, Belaga, Marudi, Serian and Tatau districts (e.g., S 21794, S 28091, S 30396, S 37453 and S 41066) and in Kalimantan (e.g., Amdjah 536 and Burley *et al.* 688).

Ecology. Understorey tree in hill and lower montane forests on limestone and sometime ultrabasic substrate, at altitudes to 1600 m.

40. *Aglaia rivularis* Merr.

(Latin, *rivulus* = brook, rivulet; referring to its natural habitat)

Sect. *Aglaia*

PEB (1929) 125; Masamune *op. cit.* 373; van Steenis *op. cit.* 291; Whitmore, Tantra & Sutisna *op. cit.* 224; Pannell *op. cit.* (1992) 247, *op. cit.* (1995) 279; PROSEA *op. cit.* (1995) 51; Beaman & Anderson *op. cit.* 123. **Lectotype** (Pannell, 1992): Elmer 21789, Borneo, Sabah, Tawau (UC; isolectotypes A, BM, G, GH, L, MICH, SING, U).

Small tree to 15 m tall, to 15 cm diameter; some branches projecting horizontally from the river bank over the water. **Bark** smooth, brown or whitish brown; inner bark reddish brown or pale brown. **Sapwood** pink or almost white. **Twig apices** densely covered with reddish brown, orange-brown or pale brown peltate scales often with a short or long fimbriate margin. **Leaves** simple, densely covered with peltate scales like that of the twigs on the midrib below, and sparsely so on the rest of the lower surface (sometimes densely when young); *blades* linear-lanceolate, $6.5\text{--}24 \times 1\text{--}4$ cm, base cuneate, margin recurved, apex acuminate, acumen to 20 mm long; midrib prominent below; lateral veins 10–17 on each side of midrib, subprominent below; intercostal venation faint but visible or occasionally subprominent below; petioles 1–2 cm long, densely covered with scales like that of the

twigs. **Inflorescences** 12–23 cm long, 6–12 cm wide, densely covered with scales like that of the twigs. **Flowers** 1–2 × 1.5–2.5 mm; *calyx divided into (rarely 4) 5 rounded lobes*, margins ciliate, outside densely covered with peltate scales; *petals 5 (rarely 6)*; staminal tube 1–1.3 × 0.9–1.5 mm, thickened inside below the bases of the anthers, margin lobed, anthers 5, ovoid, *c.* 0.3 × 0.3 mm; ovary depressed globose, 0.2–0.4 × 0.3–0.4 mm, outside densely covered with peltate or stellate scales, locule 1, containing 1 ovule, stigma ovoid or depressed globose with a central apical depression, 0.2–0.3 × 0.3–0.4 mm. **Fruits indehiscent, locule 1**, ellipsoid, *c.* 1.5 × 0.8–1 cm, brown, reddish brown or yellow; stalks to 0.8 cm long; pericarp reddish brown. **Seed** 1, surrounded by an edible aril.

Vernacular names. Sabah—*lambunan* (Dusun Labuk), *runu* (Sungei Segaliud).

Distribution. Endemic in Borneo, known only in Sabah (widespread) from Kinabatangan, Kota Belud, Kota Merudu, Labuk Sugut, Lahad Datu, Ranau, Sandakan and Tawau districts (e.g., *SAN 44708*, *SAN 69375*, *SAN 89005*, *SAN 95918* and *SAN 116405*) and in Kalimantan (e.g., *Amdjah 823*, *Arbainsyah AA 1915*, *Kostermans 12728* and *Kostermans 21189*).

Ecology. Rheophyte, found along river banks in forest on sandy soils, at altitudes 500–1000 m.

41. *Aglaia rubiginosa* (Hiern) Pannell (Latin, *rubiginosus* = rusty red; the indumentum)

Fig. 4E–G.

Sect. *Amoora*

Mal. For. 45 (1982) 455, *op. cit.* (1989) 225, *op. cit.* (1992) 92, *op. cit.* (1995) 225; Whitmore, Tantra & Sutisna *op. cit.* 225; PROSEA *op. cit.* (1995) 51; Turner *op. cit.* 338; Coode *et al.* (eds.) *op. cit.* 201. **Basionym:** *Amoora rubiginosa* Hiern *op. cit.* 561, King *op. cit.* 54, Ridley *op. cit.* (1922) 398, Corner *op. cit.* (1978) 131, 198, Anderson *op. cit.* (1980) 250. **Lectotype** (Pannell, 1982): *Griffith 1050*, Peninsular Malaysia, Malacca (K). **Synonym:** *Aglaia ignea* Valetton in K. Heyne, Nutt. Fl. Ned. Ind. 3 (1917) 59, Anderson *op. cit.* (1980) 248, Whitmore, Tantra & Sutisna *op. cit.* 222.

Tree to 20 m tall, branched. **Bark** greyish brown, flaking into long narrow scales; inner bark pale pinkish brown; latex white. **Sapwood** yellowish brown, reddish brown towards the heartwood. **Twigs** stout, with large petiole scars, *densely covered with reddish brown or dark brown stellate hairs*. **Leaves** *imparipinnate*, to 80 cm long; petioles to 20 cm long; leaflets coriaceous, above dark shiny green and pitted, *below densely covered with reddish brown stellate scales with a darker, depressed centre; lateral leaflets 9–12 on each side of rachis*, subopposite; *blades lanceolate or ovate*, 6.5–16.5 × 2.2–6 cm, base rounded or cordate, asymmetrical, margin strongly recurved, apex acuminate, acumen acute, to 10 mm long; midrib impressed above, prominent below; lateral veins 13–18 on each side of midrib, impressed above, prominent below; intercostal venation faint to invisible on both surfaces; petiolules 1–2 cm long. **Inflorescences** to 70 cm long and wide, with indumentum like that of the twigs. **Flowers** to 9 × 5 mm; *calyx shallowly 3-lobed*, with indumentum like that of the twigs; *petals 3*; staminal tube ellipsoid, shallowly 3-lobed, anthers 6, narrowly ovoid; ovary depressed globose, densely covered with stellate hairs, stigma ellipsoid with 3 apical lobes and 6 longitudinal ridges. **Fruits** ellipsoid or obovoid, *c.* 6 × 5 cm, red, *without a beak or a stalk, locules 3*, each containing 1 seed, *dehiscing into 3 lobes when ripe*. **Seeds** with a complete red aril; testa brown.

Vernacular names. Sabah—*lantupak paya* (preferred name), *lantupak* (Dusun Kinabatangan). Sarawak—*jelungan sasak* (preferred name), *bersangai* (Melanau Rejang), *chenaga gayong* (Iban), *sangai* (Melanau Oya).

Distribution. Sumatra, Peninsular Malaysia, Singapore and Borneo. In Sabah, uncommon and recorded from Beaufort, Labuk Sugut, Papar, Sandakan and Tawau districts (e.g., *SAN* 22879, *SAN* 41549, *SAN* 45052 and *SAN* 63525) and in Sarawak from Betong, Bintulu, Daro, Kuching, Lawas, Lundu, Miri, Mukah, Sarikei, Sibu and Sri Aman districts (e.g., *Pennington* 7980, *S* 9018, *S* 9807, *S* 16521 and *S* 25418). Also occurring in Brunei (e.g., *BRUN* 949 and *BRUN* 1002) and Kalimantan (e.g., *Kostermans* 8009 and *Kostermans* 10353).

Ecology. In freshwater, peatswamp and dry *kerangas* forests, at altitudes to 15 m.

42. *Aglaia rufibarbis* Ridl.

Plates 3A & B.

(Latin, *rufus* = reddish, *barba* = beard; with indumentum comprising reddish brown stellate hairs with long arms)

Sect. *Aglaia*

J. Str. Br. Roy. As. Soc. 75 (1917) 17, *op. cit.* (1922) 409; Pannell *op. cit.* (1992) 344, *op. cit.* (1995) 312; Turner *op. cit.* 338. **Type:** *Cantley* 25, Peninsular Malaysia, Johor, Mt. Ophir (holotype K).

Small tree to 5 m tall, to 5 cm diameter, sparsely branched. **Bark** usually grey and pale brown, sometimes dark brown with dark grey patches, with longitudinal cracks; inner bark green, pale yellowish brown or orange-brown, with longitudinal striations; latex white. **Sapwood** pale yellowish brown or orange-brown. **Twigs** *densely covered with reddish brown stellate hairs with arms to 4 mm long*, the hairs sometimes deciduous or the longer arms often breaking off leaving a dense cluster of short arms. **Leaves** *imparipinnate*, to 85 cm long; petioles 10–22 cm long; *leaflets with numerous stellate hairs like that of the twigs on both surfaces but more frequent on the lower one, with the arms of adjacent hairs overlapping, interspersed with smaller paler hairs with fewer arms*; lateral leaflets 3 on each side of rachis, opposite; *blades obovate or elliptical, 14–28 × 6–11 cm*, base cuneate or subcordate, asymmetrical, margin recurved, apex acuminate or caudate, acumen obtuse or acute, 5–25 mm long; midrib prominent below; lateral veins 14–21 on each side of midrib, prominent below; *intercostal venation faint but visible on both surfaces*; petiolules 0.2–4 cm long. **Inflorescences** densely stellate hairy; males to 40 cm long and wide; females to 6 cm long and wide. **Flowers** minute, subglobose, to 1.2 mm diameter; *calyx deeply divided into 5 narrow, acute lobes*, outside covered with numerous stellate hairs; *petals 5 (rarely 6), c. 1 mm long*; staminal tube nearly as long as the corolla, anthers broadly ovoid, 0.2–0.25 mm; ovary depressed globose, stigma subglobose with 2 small apical lobes. **Fruits** (young) *indehiscent, locule 1*, containing 1 seed, subglobose, *c. 2 × 2 cm*, densely covered with often deciduous stellate hairs like that of the twigs; pericarp brittle, readily torn open, *c. 1 mm thick*, inner surface smooth, white and shiny.

Distribution. Peninsular Malaysia and Borneo. In Borneo, known only in Sarawak from Belaga, Bintulu, Kapit, Kuching and Miri districts (e.g., *Mabberley* 1582, *Mabberley* 1631, *S* 13663, *S* 49152 and *S* 68534) and in Kalimantan (e.g., *Church et al.* 236 and *Winkler* 637).

Ecology. In mixed dipterocarp forest, at 100–250 m altitude.

43. *Aglaia rufinervis* (Blume) Benth.

(Latin, *rufus* = reddish, *nervus* = nerve; the indumentum on the lateral veins on the lower leaflet surface)

Sect. *Aglaia*

Acta Bot. Neerl. 11 (1962) 19; Backer & Bakhuizen *f. op. cit.* 127; Pannell *op. cit.* (1992) 317, *op. cit.* (1995) 302; PROSEA *op. cit.* (1995) 52; Turner *op. cit.* 338. **Basionym:** *Trichilia rufinervis* Blume *op. cit.* (1825) 164. **Lectotype** (Pannell, 1992): *Sin. coll.*, Java, Mt. Gede and Pangrango (L [Acc. No. 91043340]). **Synonyms:** *Aglaia trichostemon* C.DC. *op. cit.* (1878) 608, King *op. cit.* 77, Merrill *op. cit.* (1921) 323, Ridley *op. cit.* (1922) 407, Masamune *op. cit.* 373, Anderson *op. cit.* (1980) 249, Pannell *op. cit.* (1989) 227, Whitmore, Tantra & Sutisna *op. cit.* 225; *Aglaia borneensis* Merr. *op. cit.* (1917) 87, *op. cit.* (1921) 322, Masamune *op. cit.* 370, Anderson *op. cit.* (1980) 247.

Tree to 15 m tall, to 15 cm diameter, branched. **Bark** smooth, greyish brown or yellowish brown; inner bark pale brown or pale yellow; latex white. **Sapwood** pale brown or pale yellow. **Twigs** stout, *densely covered with dark brown stellate hairs*. **Leaves** imparipinnate, to 100 cm long; petioles to 12 cm long; *leaflets pale yellowish green when dry, upper surface rugulose and pitted, lower surface with numerous reddish brown pits and dense cover of reddish brown stellate scales on the midrib, and with pale brown stellate scales scattered to numerous on that surface, interspersed with a few reddish brown stellate hairs, with the arms of adjacent hairs not overlapping; lateral leaflets (5–)7–9 on each side of rachis, subopposite; blades oblong, ovate or elliptical, 6–25(–32.5) × 3–8.5(–14.5) cm, base rounded or cuneate, asymmetrical, margin slightly recurved, apex shortly caudate, acumen acute, to 10 mm long; midrib prominent below; lateral veins 10–13 on each side of midrib, subprominent below; intercostal venation faint but visible below; petiolules 1.5–3 cm long, with indumentum like that of the twigs. Inflorescences to 80 cm long, to 75 cm wide, densely covered with reddish brown stellate scales. Flowers 1.1–1.5 × 1.2–1.5 mm; *calyx divided almost to the base into 5 rounded lobes*, outside sparsely to densely covered with orange-brown or reddish brown stellate hairs or scales; corolla 1–1.3 × 1–1.4 mm, *petals* 5; staminal tube 0.7–0.8 × 0.8–1 mm, margin wavy, anthers 5, 0.4–0.5 × 0.3–0.4 mm with pale yellow simple hairs; ovary depressed globose, *c.* 0.2 × 0.2–0.3 mm, *locule* 1, containing 1 ovule, stigma ovoid, 0.3–0.4 × 0.2–0.3 mm. **Fruits** indehiscent, *locule* 1, subglobose, to 1.2 cm diameter, dull orange, *outside densely covered with dark brown or orange-brown stellate hairs and scales*.*

Vernacular name. Sarawak—*segera* (Iban).

Distribution. Sumatra, Peninsular Malaysia, Singapore, Borneo and Java. In Sabah, recorded from Keningau, Kinabatangan, Kudat, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Sipitang and Tawau districts (e.g., Pennington 7898, SAN 24881, SAN 32484, SAN 71260 and SAN 82395) and in Sarawak from Belaga, Kapit, Kuching, Lawas, Lubok Antu, Marudi, Miri and Sri Aman districts (e.g., Pennington 7969, S 31891, S 44020, S 45014 and S 46796). Also occurring in Brunei (e.g., Coode 6607, Kirkup 869 and Prance 30542) and Kalimantan (e.g., Kostermans 10680 and Laman *et al.* TL 150).

Ecology. In mixed dipterocarp forest on sandstone-derived, clay and alluvium soils, at altitudes to 860 m.

44. *Aglaia rugulosa* Pannell(Latin, *rugulosus* = somewhat wrinkled; the leaflet surface)**Sect. *Amoora***

Kew Bull. Add. Ser. 16 (1992) 73, *op. cit.* (1995) 217; Turner *op. cit.* 338. **Type:** *Whitmore FRI 15226*, Peninsular Malaysia, Pahang, Taman Negara, Ulu Sat (holotype K; isotypes KEP, L). **Synonym:** *Aglaia* sp. 1, Pannell *op. cit.* (1989) 227.

Small tree to 12 m tall, to 10 cm diameter, branched. Bark smooth, brown or greenish brown; inner bark pale brown; latex white. **Sapwood** pale yellow. **Twigs** to 2.8 cm diameter, *covered with a few to dense white or reddish brown stellate hairs or scales. Leaves* imparipinnate, to 130 cm long; petioles to 35 cm long; *leaflets* coriaceous, *dull pale brown when dry, upper surface rugulose, lower surface more markedly so and with a few stellate hairs on the midrib and lateral veins; lateral leaflets 6–7 on each side of rachis, opposite or subopposite; blades obovate or oblanceolate, 16–48 × 6–12 cm, base attenuate or sometimes cuneate or rounded, margin not recurved, apex acuminate or shortly caudate, acumen acute, to 15 mm long; midrib subprominent above, prominent below; lateral veins 9–17 on each side of midrib, usually of the same colour with leaflet surface, subprominent with longitudinal wavy ridges above, prominent and more markedly ridged below; intercostal venation faint; petiolules 2.5–4 cm long. Inflorescences* to 30 cm long, to 15 cm wide, with indumentum like that of the twigs. **Flowers** subglobose, *c.* 3 × 3 cm; *calyx shallowly divided into 3 acute lobes, with few to numerous stellate scales; corolla depressed globose, c.* 2 × 2.5 mm, *petals* 3, yellow or pale yellow, subrotund; staminal tube shorter than the corolla, cup-shaped, margin shallowly lobed, anthers 7–9, as long as the staminal tube; ovary depressed globose, *c.* 0.3 × 0.8 mm, densely covered with pale brown stellate hairs, locules 3, each containing 1 ovule, stigma ovoid, *c.* 0.4 × 0.2 mm. **Fruits** *ellipsoid or obovoid, 6–9 × 3–6 cm, locules 3, each containing 1 seed, dehiscing into 3 lobes when ripe, reddish brown or pinkish red, densely covered with compact reddish brown stellate hairs outside; pericarp 2–5 mm thick, thickest at the apex, with white latex. Seeds* 4.5 × 1.5 × 1.8 cm, completely covered with a red aril.

Distribution. Sumatra, Peninsular Malaysia, Borneo and the Philippines. In Sabah, known from Kudat and Sandakan districts (e.g., *SAN 82386*, *SAN 87646* and *SAN 111767*) and in Sarawak from Bintulu, Kapit and Miri district (e.g., *S 18314* and *S 66717*). Also occurring in Kalimantan (e.g., *Kostermans 10441*) but not yet recorded from Brunei.

Ecology. In mixed dipterocarp forest on hill sides, at altitudes to 100 m.

45. *Aglaia scortechinii* King

(Reverend Benedetto Scortechini, 1845–1886, Italian Roman Catholic missionary and government botanist at Taiping, Perak)

Sect. *Aglaia*

J. As. Soc. Beng. 64, 1 (1895) 64; Ridley *op. cit.* (1922) 403; Pannell *op. cit.* (1989) 230, *op. cit.* (1992) 175, *op. cit.* (1995) 254; Turner *op. cit.* 338. **Type:** *Scortechini 722*, Peninsular Malaysia, Perak (G, L, SING).

Tree, 22–30 m tall, to 25 cm diameter, branched. **Bark** smooth, green, greyish brown or reddish brown; inner bark yellow, pale brown or pink; latex white. **Sapwood** white. **Twig apices densely covered with dark reddish brown peltate fimbriate scales usually less than 0.2 mm diameter.** **Leaves** imparipinnate, to 45 cm long; petioles to 7 cm long; *leaflets* yellowish brown when dry, *lower surface with numerous reddish brown peltate scales on the midrib and scattered elsewhere; lateral leaflets (3–)4–6(–7) on each side of rachis; blades elliptical or ovate, 5–18.5 × 1.5–4.5 cm, base cuneate, margin recurved, apex acuminate, acumen obtuse, to 20 mm long; midrib prominent below; lateral veins 6–15 on each side of midrib, subprominent below; intercostal venation faint on both surfaces; petiolules 0.5–1 cm long.* **Inflorescences** c. 13 cm long, c. 19 cm wide, densely covered with peltate fimbriate scales like that of the twigs. **Flowers** 1.5–1.9 × 1.5–2 mm; *calyx divided into 5 lobes, outside densely covered with peltate fimbriate scales; petals 5, yellow or orange; staminal tube obovoid, 0.8–1.3 × 1.1 mm, thickened below and between the anthers, anthers 5, c. 0.5 × 0.3; ovary c. 0.2 × 0.4 mm, densely covered with orange-brown peltate scales with a fimbriate margin, locules 2 (rarely 3), each containing 1 ovule, stigma subglobose or ovoid with two apical lobes, c. 0.4 × 0.5 mm.* **Fruits indehiscent, locules 2 (rarely 3), each containing one seed, subglobose, 1.5–3 × 2–3.5 cm, red when ripe; pericarp thin and brittle when dry.** **Seeds** c. 1.3 × 1.1 × 0.9 cm, completely covered with a white or yellow aril.

Vernacular name. Sabah—*lantupak* (Dusun Kinabatangan).

Distribution. Peninsular Malaysia and Borneo. In Sabah, known from Sandakan and Sipitang districts (e.g., *SAN 16569*, *SAN 20814* and *SAN 113471*) and in Sarawak from Bau, Lubok Antu and Sri Aman districts (e.g., *Mabberley 1634*, *S 12558*, *S 33763*, *S 37513* and *S 42478*). Also occurring in Kalimantan (e.g., *Kostermans 21523* and *de Vogel 932*) but not yet recorded from Brunei.

46. *Aglaia sessilifolia* Pannell

(Latin, *sessilis* = stalkless or apparently so, *folium* = leaf)

Sect. *Aglaia*

Kew Bull. 59 (2004) 88. **Type:** *George et al. SAN 117676*, Borneo, Sabah, Kinabatangan district, Bt. Goram (holotype K; isotypes KEP, SAN).

Tree to 12 m tall; bole to 6 m, to 20 cm diameter, branched. **Bark** greyish brown or dark brown, slightly scaly; inner bark reddish brown or whitish brown, fibrous. **Sapwood** pinkish brown or pinkish yellow; latex white. **Twigs densely covered with yellowish brown stellate hairs and scales interspersed with compact reddish brown stellate hairs.** **Leaves** simple, dull pale yellowish green when dry, with few to numerous hairs and scales like that of the twigs on the midrib below and scattered on the rest of that surface; *blades obovate, 12–36 × 3–11.5 cm, base cordate or rounded, margin planar, apex acuminate, acumen c. 10 mm long; midrib prominent below, with a 5–10 mm long pulvinus-like swelling at 5–12 mm from the leaf base; lateral veins 17–30 on each side of midrib, ascending and curved upwards near the margin, not or quite anastomosing, subprominent below; intercostal*

venation visible but not subprominent below; petioles 0.5–0.7 cm long or leaves sessile. **Inflorescences** to 18 cm long, to 10 cm wide; peduncles, branches and pedicels with numerous to dense yellowish brown stellate hairs and scales. **Flowers** 2–2.7 × 1.7–2.4 mm; pedicels *c.* 1.5 mm long; *calyx* cup-shaped, *divided almost to the base into 5 ovate lobes* about 1 mm long, with a few yellowish brown stellate scales about 0.1 mm in diameter; *petals* 5, obovate, *c.* 1.9 × 1.5 mm, yellow, aestivation quincuncial; staminal tube obovoid, 1–1.9 × 1–1.3 mm, shallowly lobed, anthers 4 or 5; ovary 0.3 × 0.3–0.5 mm, densely covered with scales like that of the calyx, style 0.2–0.5 mm long, stigma subglobose, 0.3–0.6 mm diameter, with four shallow lobes and darker depressed apical lobe *c.* 0.3 mm in diameter; locule 1. **Fruits** indehiscent, *locule* 1, ellipsoid, *c.* 2.5 × 1.6 cm, with few yellowish brown stellate hairs and scales.

Distribution. Endemic in Borneo and known only in Sabah from Keningau, Kinabatangan and Sandakan district (e.g., *SAN 30696*, *SAN 90877*, *SAN 117676* and *SAN 135055*).

Ecology. In limestone hill forest, at altitudes to 1000 m.

47. *Aglaia sexipetala* Griff.

(Latin, *sex* = six, *petalum* = petal; flower with 6 petals)

Sect. *Aglaia*

Not. Pl. As. 4 (1854) 505; Pannell *op. cit.* (1995) 268; Turner *op. cit.* 338; Coode *et al.* (eds.) *op. cit.* 201; Beaman & Anderson *op. cit.* 124. **Type:** *Griffith 1036*, Burma (= Myanmar), Ching, Nhinghuk (holotype K). **Synonyms:** *Aglaia aspera* Teijsm. & Binn. *op. cit.* (1864) 42, Miquel *op. cit.* (1868) 52, Koorders & Valetton *op. cit.* (1913) t. 152, Backer & Bakhuizen *f. op. cit.* 127, Pannell *op. cit.* (1989) 211, *op. cit.* (1992) 217, Whitmore, Tantra & Sutisna *op. cit.* 220, PROSEA *op. cit.* (1995) 43; *Aglaia calelanensis* Elmer *op. cit.* 3283; *Aglaia* sp. 5, Pannell *op. cit.* (1989) 229.

Tree to 15 m tall, to 30 cm diameter, branched; buttresses (if present) to 30 cm tall, to 30 cm out. **Bark** brown, dark grey, reddish brown with white brown patches; inner bark reddish brown; latex white. **Sapwood** white. **Twigs** slender, almost smooth, *densely covered with reddish brown stellate scales*. **Leaves** imparipinnate, to 72 cm long; petioles to 17 cm long; *leaflets* usually brown when dry, upper surface with a few stellate scales and numerous pits, *lower surface with numerous scales like that of the twigs, interspersed with compact brown stellate hairs with many, overlapping, short arms c. 0.5 mm long*; lateral leaflets 4–8 on each side of rachis, subopposite; *blades elliptical, lanceolate-oblong, oblong, ovate or obovate, 6–17 × 2–6 cm*, base rounded, subcordate or cuneate, asymmetrical, margin recurved and somewhat undulate, apex acuminate, acumen obtuse or acute, 10–15 mm long; midrib below prominent and with numerous to dense cover of scales like that of the twigs or with peltate scales with a long fimbriate margin; lateral veins 12–16 on each side of midrib, subprominent below; *intercostal venation faint on both surfaces*; *petiolules 1.2–3.5 cm long*. **Inflorescences** (males) to 40 cm long, 40–50 cm wide, with indumentum like that of the twigs. **Flowers** *c.* 1 × 1.1 mm; *calyx divided almost to the base into 5 subrotund lobes*, outside with numerous stellate scales; *petals* 5, elliptical or subrotund, yellow; staminal tube cup-shaped, *c.* 0.5 × 0.7 mm, apical margin incurved and shallowly 5-lobed, anthers 5, *c.* 0.2 × 0.2 mm; ovary subglobose, densely covered with stellate hairs or scales, stigma depressed globose, *c.* 0.2 × 0.3 mm. **Fruits** indehiscent, *locules* 2, each containing 1 seed, subglobose, 1.7–2.2(–3) × 1.4–2(–2.7) cm, yellowish brown, reddish brown or orange-brown; *pericarp to 2 mm thick, hard and brittle or woody when dry*, sometimes with white latex. **Seeds** completely covered with transparent or white aril.

Vernacular names. Sabah—*lantupak* (Dusun Kinabatangan). Sarawak—*segera* (Iban).

Distribution. Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines (type of *A. calelanensis* only) and New Guinea. Fairly common in Sabah and known from Beaufort, Labuk Sugut, Sandakan, Tambunan and Tawau districts (e.g., *SAN* 29631, *SAN* 32255, *SAN* 71188, *SAN* 78218 and *SAN* 97645) and in Sarawak from Belaga, Bintulu, Kapit, Lundu, Marudi, Miri and Simunjan districts (e.g., *S* 23835, *S* 24133, *S* 34273, *S* 39256 and *S* 43370). Also occurring in Brunei (e.g., *Ashton* B1, *Coode* 6955 and *Kirkup* DK 906) and Kalimantan (e.g., *Argent* & *Saridan* 9337, *Burley et al.* 2414, *Jarvie* & *Ruskandi* 6405, *Leighton* 213, *Wilkie* 94191 and *Wilkie* 93403).

Ecology. In mixed dipterocarp and *kerangas* forests on white sandy soil, at altitudes to 860 m.

48. *Aglaia silvestris* (M.Roem.) Merr.

(Latin, *silvestris* = of forest; growing wild)

Sect. *Aglaia*

Interpr. Rumph. Herb. Amboin. (1917) 210; Pannell *op. cit.* (1992) 193, *op. cit.* (1995) 259; PROSEA *op. cit.* 52; Turner *op. cit.* 338; Coode *et al.* (eds.) *op. cit.* 201; Beaman & Anderson *op. cit.* 124. **Basionym:** *Lansium silvestre* M.Roem., Fam. Nat. Syn. Monogr. 1 (1846) 99. **Neotype** (Pannell, 1992): *C.B. Robinson Herbarium Amboinense* 490, Maluku, Ambon (PNH; isoneotypes BM, BO, K, L, NY, P). **Synonyms:** *Aglaia ganggo* Miq. *op. cit.* (1861) 506, *op. cit.* (1868) 47, King *op. cit.* 65, Koorders & Valetton *op. cit.* (1913) t. 156, Backer & Bakhuizen *f. op. cit.* 129, Pannell *op. cit.* (1989) 216, Whitmore, Tantra & Sutisna *op. cit.* 222; *Aglaia acuminata* Merr. *op. cit.* (1915) 531; *Aglaia micropora* Merr. *op. cit.* (1929) 129, Masamune *op. cit.* 372, Anderson *op. cit.* (1980) 249; *Aglaia copelandii* Elmer *op. cit.* 3286.

Tree to 30 m tall, to 35 cm diameter, branched; buttresses (if present) to 3 m tall and 1 m out. **Bark** pale greyish brown, pale yellow, greenish yellow or reddish brown, with longitudinal rows of lenticels, sometimes flaky; inner bark reddish brown, pale brown, orange, pale yellow; latex white or sap red and watery. **Sapwood** paler than inner bark; heartwood pale yellowish brown or almost white. **Twigs** slender, *densely covered with peltate scales with a dark brown centre and pale, sometimes fimbriate margin*. **Leaves** *imparipinnate*, 19–65 cm long; petioles 10–20 cm long; *leaflets* subcoriaceous, *upper surface sometimes with dense scales like that of the twigs when young but deciduous before maturity, lower surface sparsely to densely covered with similar scales*; lateral leaflets (rarely 2) 6–8 on each side of rachis, alternate; *blades lanceolate or elliptical*, 6.5–17 × 1.2–5.5 cm, base rounded or abruptly cuneate, sometimes asymmetrical, margin recurved, apex acuminate, acumen obtuse, to 18 mm long; midrib prominent below; lateral veins 7–17 on each side of midrib; intercostal venation faint on both surfaces; petiolules 0.5–2 cm long, densely covered with peltate scales like that of the twigs. **Inflorescences** to 30 cm long, to 20 cm wide, densely covered with peltate scales like that of the twigs. **Flowers** obovoid, 2–2.7 × 1.4–2.6 mm; *calyx* to half the length of corolla, *deeply divided into 5 broadly ovate, ciliate lobes*, densely covered with peltate scales like that of the twigs; *petals* 5 or rarely 6, yellow, elliptical or ovate; *staminal tube* obovoid, 1–1.4 × 0.7–1.7 mm, *with a narrow pin-*

prick aperture c. 3 mm diameter with an entire margin, anthers 5, included, ovoid, 0.8–1 × 0.3–0.4 mm; ovary depressed globose, c. 0.4 × 0.4 mm, stigma ovoid, 0.4–0.7 × 0.2–0.4 mm. Fruits indehiscent, locules 1 or 2 (rarely 3), each containing 1 seed, usually obreniform (= inverted kidney-shaped) in outline, longitudinally flat, c. 2.1 × 1.8 × 0.9 cm; pericarp densely covered with peltate scales like that of the twigs, orange, with white latex, wrinkled when dry; stalks to 1 cm long. Aril thin, brown, translucent and sweet.

Vernacular names. Sabah—*langsats-langsats* (Malay), *lantupak* (Dusun Kinabatangan). Sarawak—*buniau* (Iban), *bunya* (Iban), *bunyo* (Kayan), *gayan* (Kayan), *lepuniau* (Kenyah), *segera* (Iban).

Distribution. Andaman Islands, Nicobar Islands, Vietnam, Cambodia, Thailand, Sumatra, Peninsular Malaysia, Borneo, the Philippines, Java, Sulawesi, Maluku, New Guinea, New Britain and Solomon Islands. In Sabah, recorded from Keningau, Ranau, Sandakan and Tawau districts (e.g., *SAN 40906*, *SAN 50323*, *SAN 74479*, *SAN 84122* and *SAN 89503*) and in Sarawak from Bintulu, Kapit and Kuching districts (e.g., *S 27469*, *S 32063*, *S 37459*, *S 43906* and *S 44185*). Also occurring in Brunei (e.g., *SAN 17450* and *Sands 5530*) and Kalimantan (e.g., *Kostermans 9956*, *Laman et al. TL 295* and *Leighton 772*).

Ecology. In mixed dipterocarp and *kerangas* forests, often on limestone-derived or clay-rich soils, at altitudes to 1650 m.

49. *Aglaia simplicifolia* (Bedd.) Harms

(Latin, *simplex* = simple, *folium* = leaf)

Sect. *Aglaia*

In Engler & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 300; Pannell *op. cit.* (1992) 306, *p.p.*, *op. cit.* (1995) 298, *p.p.*; Turner *op. cit.* 338, *p.p.*; Coode *et al.* (eds.) *op. cit.* 202; Beaman & Anderson *op. cit.* 124. **Basionym:** *Beddomea simplicifolia* Bedd., Fl. Sylv. 1 (1871) t. 135. **Lectotype** (Pannell, 1992): *Beddome* '1165', India, Tinnevely hills (BM). **Synonym:** ?*Beddomea racemosa* Ridl., J. Fed. Malay. States 4 (1909) 10.

Tree, 15–20 m tall, 15–20 cm diameter, branched. **Bark** smooth, greyish brown. **Sapwood** white. **Twigs** pale greyish or yellowish brown, with dense reddish brown stellate hairs at the apex only. **Leaves** simple, surfaces dull (pale green) when dry, below with occasional hairs like that of the twigs on the midrib; blades elliptical or obovate, 7–18 × 2.5–7.5 cm, base cuneate or rounded, margin planar, apex acute or obtuse; midrib prominent below, somewhat impressed above; lateral veins 14–22 on each side midrib, ascending and curved upwards near the margin and not or just anastomosing; intercostal venation inconspicuous on both surfaces; petioles 0.5–1.7 cm long. **Inflorescences** and **flowers** unknown from Borneo. **Infructescences** to 6 cm long and 5 cm wide; peduncles 5–10 mm long. **Fruits** indehiscent, subglobose, c. 2.2 × 1.9 cm, red when ripe, not curved, without stipe, with one longitudinal ridge around it; peduncle, branches, and fruits with dense hairs like that of the twigs.

Vernacular name. Sarawak—*segera* (Iban).

Distribution. India, Laos, Thailand, Sumatra, Peninsular Malaysia and Borneo. In Borneo, known only in Sabah from Keningau district (e.g., *SAN 71980*, *SAN 74450* and *SAN 107406*) and in Sarawak from Marudi district (e.g., *S 22844*).

Ecology. In lowland and lower montane forests at altitudes to 1500 m.

Notes. A large number of specimens collected from Sabah and Sarawak previously identified as *Aglaia simplicifolia* (Pannell *op. cit.* 1992 & *op. cit.* 1995) belong to *A. meliosmoides*.

50. *Aglaia soepadmoi* Pannell

Fig. 8.

(Engkik Soepadmo, 1937–, Coordinator and Chief Editor, Tree Flora of Sabah and Sarawak Project)

Sect. *Aglaia*

Gard. Bull. Sing. 57, 2 (2005) 183. **Type:** *Othman et al. S 59970*, Borneo, Sarawak, Lundu district, Sg. Sebuloh (holotype SAR; isotype KEP).

Small tree to 7 m tall, branched. **Twigs** longitudinally channelled, *densely covered with dark brown or blackish brown stellate hairs, interspersed with pale stellate scales*. Leaves and inflorescences crowded near the apices of the shoots. **Leaves** *imparipinnate (only occasionally paripinnate)*, to 95 cm long; petioles 22–28 cm long; petioles, rachis and petiolules channelled adaxially, with indumentum like that of the twigs; leaflets above shiny-green, *smooth on both surfaces*, below densely covered with white stellate scales interspersed with dark brown, stellate hairs; *lateral leaflets 4 or 5 on each side of rachis*, opposite; *blades ovate or elliptical, the terminal one often markedly obovate, 15.5–24 × 6–9 cm*, base cordate, apex acuminate (rarely rounded), acumen acute to 16 mm long; midrib impressed above, prominent below; *lateral veins 11–17 on each side of midrib*, impressed above, subprominent below, ascending and markedly curved upwards and looped at the margin; *intercostal venation reticulate, visible above, slightly prominent below*; *petiolules c. 0.5 cm long*. **Inflorescences** to 17 cm long, to 9 cm wide, densely covered with indumentum like that of the twigs. **Flowers** sessile, subglobose, *c. 1.3 × 1.3 mm*; *calyx divided into 5 lobes*, outside densely covered with reddish brown stellate hairs and scales; *petals 5*; staminal tube obovoid, with a shallowly lobed aperture *c. 0.2 mm* across, anthers 5, almost as long as the staminal tube, inserted longitudinally and visible through the aperture; ovary subglobose, stigma ovoid with two apical lobes. **Infructescences** *c. 18.5 cm long*. **Fruits** *indehiscent*, subglobose, *c. 2 × 2 cm*, *densely covered with dark brown stellate hairs interspersed with a few white hairs*.

Ecology. Lowland mixed dipterocarp forest and beach forest on rocky terrain, at altitudes to 1100 m.

Distribution. Sumatra and Borneo. In Borneo, known only in Sarawak from Kuching and Lundu districts (e.g., *S 41873*, *S 54426*, *S 54873*, *S 63857* and the type).

51. *Aglaia speciosa* Blume

(Latin, *speciosus* = beautiful, showy, splendid)

Sect. *Aglaia*

Bijdr. Fl. Ned. Ind. (1825) 171; Miquel, Fl. Ind. Bat. 1 (1859) 543, *op. cit.* (1868) 46; Koorders & Valeton *op. cit.* (1913) t. 162; Backer & Bakhuizen *f. op. cit.* 127; Whitmore, Tantra & Sutisna *op. cit.* 225; Pannell *op. cit.* (1992) 164, *op. cit.* (1995) 250; PROSEA *op. cit.* (1995) 53; Turner *op. cit.* 338; Beaman & Anderson *op. cit.* 124. **Lectotype** (Pannell, 1992): *Anon.* 627, Java, Mt. Salak (L [Acc. No. 9081321091]).

Tree to 35 m tall, to 60 cm diameter, branched; buttresses to 1.3 m tall, to 1 m out. **Bark** grey or pink; inner bark reddish brown or greyish brown; latex white. **Sapwood** pale yellow or white, pinker towards the heartwood. **Twigs** with pinkish orange lenticels scattered or in longitudinal rows, *densely covered with peltate scales with a dark reddish brown centre and pale, sometimes fimbriate margin*. **Leaves** imparipinnate, 25–30 cm long; petioles 4.5–10 cm long; *leaflets below with numerous scales like that of the twigs*, lateral leaflets 1–2(–6) on each side of rachis, subopposite; *blades narrowly elliptical or narrowly obovate, 3.2–12 × 2–3.5 cm*, base rounded or cuneate, margin planar to slightly recurved, apex acuminate, acumen obtuse, to 10 mm long; midrib impressed above, prominent below; lateral veins 6–12 on each side of midrib, barely prominent below; intercostal venation faint on both surfaces; petiolules 0.5–1 cm long. **Inflorescences** to 22 cm long, to 20 cm wide, densely covered with scales like that of the twigs. **Flowers** 1.5–2 × 1.7–2 mm; calyx 0.5–1.5 mm long, densely covered with peltate, fimbriate scales; *petals 5*; *staminal tube* cup-shaped, 0.8–1.2 × 1–1.5 mm, *aperture more than 0.3 mm diameter, margin incurved and shallowly lobed*, *anthers 5*, 0.3–0.5 × 0.3–0.4 mm, *protruding through the aperture of staminal tube*; ovary ovoid, 0.2–0.4 × 0.2–0.5 mm, densely covered with scales like that of the twigs, locules 2, stigma subglobose or depressed globose, 0.2–0.5 × 0.4–0.5 mm. **Fruits** indehiscent, locules 2 (*rarely 1*), each containing 0 or 1 seed, *obovoid*, 2.3–3 × 1.7–2.7 cm, red, orange or brown when ripe; *pericarp c. 1 mm thick, brittle, without dehiscing lines*. **Seeds** arillate, the aril c. 2 mm thick, translucent, yellow or orange, edible, firmly adhering to the testa; seeds without aril c. 1.6 × 1.3 × 0.8 cm.

Distribution. Sumatra, Peninsular Malaysia, Borneo and Sulawesi. In Borneo, known only in Sabah from Keningau, Ranau, Sandakan and Tambunan districts (e.g., *Pennington* 7926, *SAN* 40301, *SAN* 41886, *SAN* 87421 and *SAN* 87883) and in Sarawak from Lundu and Miri district (e.g., *S* 406, *S* 26596, *S* 27569 and *S* 82971).

Ecology. In forests at altitudes to 1350 m.

52. *Aglaia spectabilis* (Miq.) S.S.Jain & Bennet

Fig. 9.

(Latin, *spectabilis* = visible, worth seeing)

Sect. *Amoora*

Ind. J. For. 9 (1987) 271; Pannell *op. cit.* (1992) 79, *op. cit.* (1995) 221; PROSEA *op. cit.* (1995) 53; Turner *op. cit.* 339. **Basionym:** *Amoora spectabilis* Miq. *op. cit.* (1868) 37. **Syntypes:** *Anon. Herb. E.I.C.* 1278 (K) and 1278.1 (K-W), Cult. in Hortus Calcuttensis. **Synonyms:** *Amoora ridleyi* King *op. cit.* 56, *Ridley op. cit.* (1922) 398, Whitmore, Tantra & Sutisna *op. cit.* 224; *Amoora wallichii* King *op. cit.* 56; *Aglaia ridleyi* (King) Pannell *op. cit.* (1982) 455, *op. cit.* (1989) 223.

Tree to 30 m tall, to 60 cm diameter, branched; buttresses plank-shaped, to 2 m tall and out. **Bark** greyish brown, yellowish brown or pale orange-brown, flaking in squarish scales, sometimes with large orange lenticels; inner bark pink, pale yellow or brown; latex white. **Sapwood** pale brown or white, reddish brown towards the heartwood. **Twigs** stout, *densely covered with reddish brown or pale yellowish brown stellate hairs or scales, or peltate*

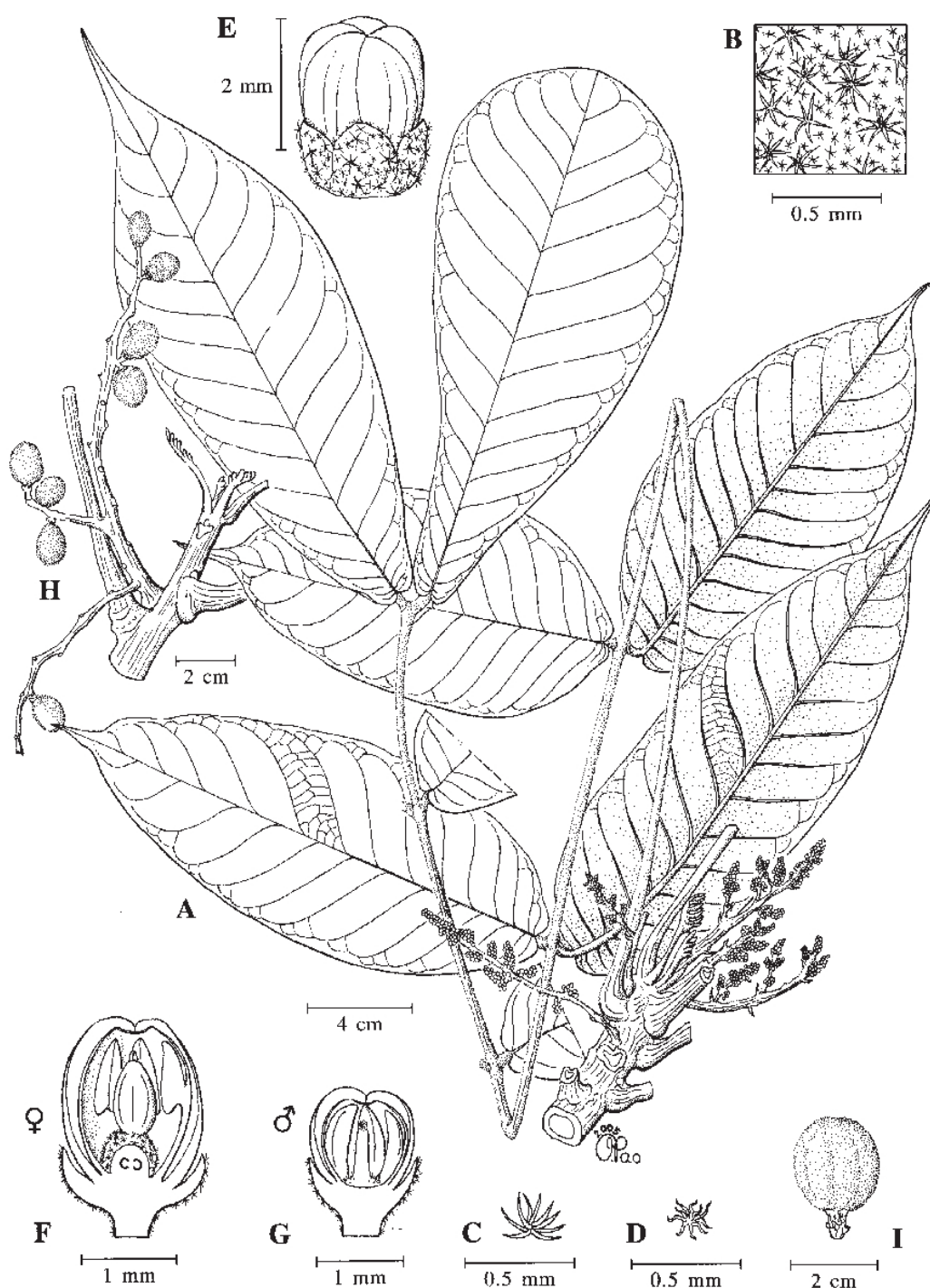


Fig. 8. *Aglaia soepadmoi*. A, leafy twig with young male inflorescences; B, detail of lower leaflet surface showing indumentum; C, stellate hairs; D, stellate scales; E, female flower; F, longitudinal section of female flower; G, longitudinal section of young male flower; H, young infructescence; I, young fruit. (A–D and G from *S* 41873, E–F from *S* 59970, H from *S* 54426, I from *Jacobs* 8190.)

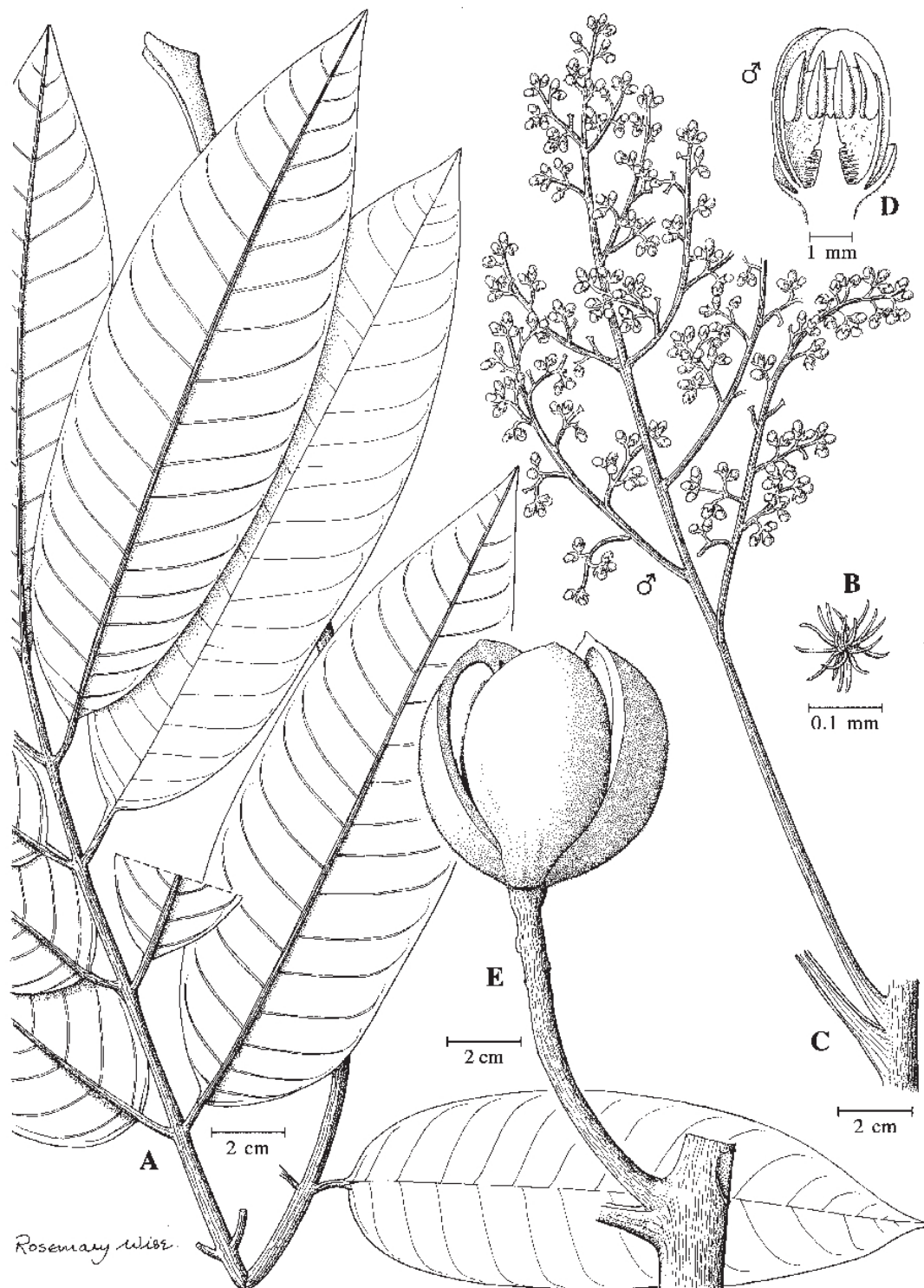


Fig. 9. *Aglaia spectabilis*. A, leaf; B, stellate hair; C, inflorescence; D, longitudinal section of male flower; E, infructescence. (After Pannell, Kew Bull. Add. Ser. 16 (1992) 82, f. 13 and FMI, 12(1) (1995) 220, f. 33; A–B from Putz FR123647, C–D from Wray 2107; E from Ridley 5027.)

scales with a fimbriate margin. **Leaves** imparipinnate, 50–135 cm long; petioles 14–25 cm long; leaflets coriaceous, dull brownish when dry, upper surface rugulose and sometimes pitted, lower surface pitted, with few to dense pale brown or orange-brown stellate hairs or scales on the midrib and a few or occasionally dense on the lateral veins and the blade, sometimes with a few darker peltate fimbriate scales scattered on the rest of that surface; lateral leaflets 7–10 on each side of rachis, opposite or subopposite; blades lanceolate, oblong or elliptical, 8.5–26 × 3.5–7 cm, base rounded, asymmetrical, margin planar, apex acuminate, acumen acute, to 15 mm long; midrib impressed above, prominent below; lateral veins 9–19 on each side of midrib, impressed above, prominent below, usually the same colour as the leaflet surface; intercostal venation subprominent below; petiolules 0.8–2 cm long. **Inflorescences** to 50 cm long, to 30 cm wide, with indumentum like that of the twigs. **Flowers** ellipsoid, 5–7 × 3–6 mm; calyx divided to halfway into 3 obtuse lobes, outside densely covered with stellate hairs; corolla tube c. 4 mm long, deeply divided into 3 lobes; staminal tube cup-shaped, c. 3 × 2.5 mm, anthers 6–9, 1.3 × 0.7 mm; ovary subglobose, c. 0.4 × 0.9 mm, stigma ovoid, c. 0.6 × 0.8 mm. **Infructescences** to 13 cm long. **Fruits** ellipsoid, 8–10 × 6–8 cm, locules 3 (rarely 4), each containing 0 or 1 seed, dehiscing into 3 lobes when ripe; pericarp to 1 cm thick, with white latex, shiny reddish brown inside. **Seeds** c. 3.5 × 2.5 × 1.8 cm; aril c. 1 mm thick, brown, red or yellow.

Vernacular names. Sabah—*balim* (Kedayan), *langsar-langsar* (Malay), *lantupak* (Dusun Kinabatangan), *merasam* (Banjar-Malay).

Distribution. India (Sikkim), Myanmar, Laos, Cambodia, Vietnam, China, Thailand, Sumatra, Peninsular Malaysia, Borneo, the Philippines, Sulawesi, Nusa Tenggara (Sumba), New Guinea, New Britain, Solomon Islands, Santa Cruz Islands and Australia (Cape York Peninsula). In Borneo, known only in Sabah from Labuk Sugut, Sandakan and Tawau districts (e.g., *SAN 31301*, *SAN 40895*, *SAN 42151*, *SAN 62942* and *SAN 81407*) and in Sarawak from Lundu district (e.g., *S 41879*).

Ecology. In lowland forest, at altitudes to 250 m.

53. *Aglaia squamulosa* King

(Latin, *squamulosus* = covered with small scales; the indumentum on the lower leaflet surface and other parts of the plant)

Sect. *Aglaia*

J. As. Soc. Beng. 64, 1 (1895) 68; Ridley *op. cit.* (1922) 407; Pannell *op. cit.* (1989) 225, *op. cit.* (1992) 129, *op. cit.* (1995) 239; Whitmore, Tantra & Sutisna *op. cit.* 225; Turner *op. cit.* 339; Coode *et al.* (eds.) *op. cit.* 202; Beaman & Anderson *op. cit.* 124. **Syntypes:** *King's collectors 8805*, Peninsular Malaysia, Perak, near Ulu Kerling (K, SING); *King's collectors 11013*, Perak, Ulu Bubong (BM, K); *King's collectors 10145*, Perak, Ulu Bubong (BM, K, SING). **Synonym:** *Aglaia cuprea* Elmer *op. cit.* 3287.

Tree to 20 m tall, to 40 cm diameter, branched; buttresses (if present) L-shaped, to 55 cm tall and 36 cm out. **Bark** brown, pale green, pale orange-brown, pinkish brown, pale brownish grey or grey, sometimes with transverse and longitudinal striations or rows of

lenticels; inner bark yellowish brown, orange or green; sometimes with white latex. **Sapwood** brown or pale yellowish pink, pale brown or orange; heartwood magenta. **Twigs** stout, *thickly covered with shiny, large (at least 0.25 mm diameter) peltate scales with a brown centre and brown or pale brown shortly fimbriate margin*. **Leaves** *imparipinnate*, to 90 cm long; petioles to 20 cm long; *leaflets* coriaceous, dark yellowish green above, paler below, *when young both surfaces densely covered with pale brown or colourless, shiny, peltate scales, when mature upper surface rugose and with a few scattered scales, lower surface with numerous to dense scales, that of the midrib reddish brown; lateral leaflets 4–7 on each side of rachis*, usually alternate, sometimes subopposite; *blades oblong, elliptical or elliptical-oblong, 4–30 × 2–10 cm*, base rounded or cuneate, asymmetrical, margin recurved, apex acuminate, acumen obtuse or acute, to 15 mm long; midrib prominent below; lateral veins 4–13 on each side of midrib, subprominent below; intercostal venation inconspicuous on both surfaces; petiolules 0.3–2 cm long. **Inflorescences** to 39 cm long, 20 cm wide, *thickly covered with scales like that of the twigs*. **Flowers** 3.2–5 × 2(–2.9) mm; *calyx* wrinkled and densely covered with peltate scales near the base, *divided almost to the base into 5 (rarely 6) subrotund obtuse lobes*; corolla *c.* 2 × 2.9 mm long, *petals* 5; staminal tube obovoid, 1–2.1 × 1–2.3 mm, yellow, shallowly 5-lobed, anthers ovoid, *c.* 0.5 × 0.3 mm, densely covered with white stellate hairs; ovary depressed globose, *c.* 0.4 × 0.7 mm, densely covered with brown peltate scales, locules 2, stigma ovoid with two small apical lobes, *c.* 0.7 × 0.5 mm. **Fruits** *indehiscent, locules 2*, each containing 1 seed, narrowly obovoid when young, subglobose when mature, 5–5.7 × 3.5–4.7 cm, often with beak to 5 mm long and stalk to 5 mm long, brown or yellow; pericarp to 1 cm thick. **Seeds** *c.* 1.8 cm diameter; aril 0.3–1 mm thick, translucent, white.

Vernacular names. Sabah—*lantupak* (Dusun Kinabatangan). Sarawak—*segera* (Iban).

Distribution. Sumatra, Peninsular Malaysia, Borneo, the Philippines, Sulawesi and Nusa Tenggara (Sumbawa). In Sabah, known from Kinabatangan, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Tawau and Tenom districts (e.g., *SAN 65861*, *SAN 73523*, *SAN 76806*, *SAN 87879* and *SAN 99426*) and in Sarawak from Kapit, Limbang and Sri Aman districts (e.g., *S 28538*, *S 36074*, *S 36213*, *S 52437* and *S 60769*). Also occurring in Brunei (e.g., *Ashton 1256*, *BRUN 1067*, *Simpson 5238* and *Wong WKM 1908*) but not yet recorded from Kalimantan.

Ecology. In forests on sandstone-derived, sandy, clay and loam soils, at altitudes to 2000 m.

54. ***Aglaia stellatopilosa*** Pannell
(Latin, *stellato-pilosus* = having stellate hairs)

Fig. 5L–P.

Sect. ***Aglaia***

Kew Bull. 59 (2004) 88. **Type:** *Awa & Lee S 47672*, Borneo, Sarawak, Limbang district, G. Pagon, Ulu Sg. Sipayan (holotype FHO; isotypes K, KEP, L, SAN, SAR).

Tree to 8 m tall, to 10 cm diameter, *branched*. **Bark** greyish green, sometimes pale brownish orange with V-shaped fissures; inner bark orange; latex white. **Twigs** *densely covered with pale brown or orange brown stellate hairs with wavy arms*. **Leaves** *imparipinnate*, 15–25 cm long; petioles 3–5 cm long; *leaflets with numerous pits on both surfaces*, lower surface with a few pale brown stellate hairs or scales on the midrib; lateral leaflets (rarely 3) 4–6 on

each side of rachis, alternate or subopposite, *basal ones only slightly smaller than the rest*; blades narrowly ovate-elliptical, $2-6 \times 1-1.8$ cm, usually pale green when dry, sometimes blackish green, base attenuate-acute, somewhat asymmetrical, margin recurved, apex acuminate-caudate, acumen to 10 mm long, with blunt tip; midrib prominent below, subprominent above; lateral veins 4-6 on each side of midrib, darker or paler than the rest of the blade when dry; intercostal venation inconspicuous on both surfaces; petiolules to 0.5 cm long. **Inflorescences** to 12 cm long and wide. **Flowers** $1.5-1.9 \times 1.2-1.8$ mm; calyx densely covered with stellate scales; petals 5 (rarely 6); staminal tube $1-1.3 \times 0.8-1$ mm, anthers $0.5-0.6 \times 0.3$ mm; ovary ovoid, $0.3-0.4 \times 0.3-0.4$ mm, locules 2, stigma $0.3 \times 0.2-0.3$ mm. **Fruits** indehiscent, locules 2, subglobose, c. 2.3×2 cm, yellow, orange or deep yellowish brown when ripe, without longitudinal ridges.

Vernacular name. Sarawak—*kela buno* (Kelabit), *segera* (Iban).

Distribution. Endemic in Borneo. In Sabah, known from Keningau, Pensiangan, Ranau, Sandakan, Tenom and Tawau districts (e.g., *SAN 72091*, *SAN 114451*, *SAN 18554*, *SAN 24037* and *SAN 124794*) and in Sarawak from Kuching, Limbang, Lubok Antu, Marudi and Sri Aman districts (e.g., *S 37961*, *S 35354*, *S 47672*, *S 54001* and *S 58339*). Also occurring in Kalimantan (e.g., *Church et al. 458* and *Endert 3618*) but not yet recorded from Brunei.

Ecology. In mixed dipterocarp, riparian and *kerangas* forests, at altitudes to to 1200 m.

55. *Aglaia sterculioides* Kosterm.

Fig. 7J-N.

(like *Sterculia*, Malvaceae s.l. [Sterculiaceae]; referring to the fruit)

Sect. *Aglaia*

Reinwardtia 7, 5 (1969) 434. **Type:** *Hallier 3114*, Borneo, Kalimantan, Amai Ambit (holotype BO; isotypes K, L). **Synonym:** *Aglaia simplicifolia* auct. non (Bedd.) Harms (1896), p.p.: Pannell *op. cit.* (1992) 306, p.p., *op. cit.* (1995) 298, p.p.

Slender tree to 8 m tall, to 8 cm diameter, branched. **Bark** surface brown, smooth. **Twigs** grey or dark brown, densely covered with reddish brown stellate hairs when young. **Leaves** simple, dull brownish green when dry; midrib, lateral veins on lower surface and petioles with numerous to dense cover of hairs like that of the twigs; blades elliptical, (7-)14-29 \times (3-)4-10 cm, base rounded or cuneate, margin recurved, apex acute, acumen to 15 mm long; midrib prominent below; lateral veins 9-14(-18) on each side of midrib, subprominent below; intercostal venation just visible on both surfaces; petioles 1-2 cm long. **Inflorescences** c. 13 cm long and c. 12 cm wide, densely covered with hairs like that of the twigs; peduncles to 15 mm long. **Flowers** $1.3-1.5 \times 1.8-2$ mm; pedicels 0.3-1.5 mm long; calyx c. 0.5 mm long, divided almost to the base into 5 ovate lobes; petals 5, yellow, aestivation quincuncial; staminal tube shallowly cup-shaped, $0.7-1.2 \times 1.4-1.5$ mm, anthers 5; ovary c. 0.1×0.1 mm, densely covered with pale orange-brown stellate hairs, style 0.5 mm long, stigma ovoid, $0.2-0.3 \times 0.2$ mm. **Infructescences** 8.5-21 cm long, with 1-4 fruits; peduncles 3.5-11 cm long. **Fruits** indehiscent, ellipsoid, $4.6-6 \times 1.3-3.5$ cm, curved with a stalk to 1 cm long, a beak to 3 mm long and a longitudinal ridge around it, greenish brown, ripening orange.

Distribution. Endemic in Borneo. In Sabah, known from Lahad Datu district (e.g., *SAN* 58129) and in Sarawak from Bintulu, Miri and Tatau districts (e.g., *S* 21330, *S* 27853, *S* 39858, *S* 44821 and *S* 51427). Also occurring Brunei (e.g., *BRUN* 15386 and *BRUN* 15387) and in Kalimantan (e.g., the type collection).

Ecology. In lowland mixed dipterocarp on alluvial soil, at altitudes to 50 m.

Notes. Pannell (*op. cit.* 1992 & *op. cit.* 1995) treated this species as conspecific with *Aglaia simplicifolia*. It differs from *A. simplicifolia*, however, in its persistent indumentum on the midrib and lateral veins below and its curved fruit with a short stalk and beak.

56. *Aglaia subsessilis* Pannell

(Latin, *sub* = almost, *sessilis* = sessile, stalkless; the leaflets)

Sect. *Aglaia*

Kew Bull. Add. Ser. 16 (1992) 273, *op. cit.* (1995) 286; Beaman & Anderson *op. cit.* 125. **Type:** *Dewol SAN 93651*, Borneo, Sabah, Kinabatangan district, Pinangah, Kg. Saguean (holotype FHO; isotypes KEP, SAN).

Tree to 15 m tall, *branched*. **Bark** thin, dark reddish brown or white with black patches, scaly, with brown lenticels; inner bark reddish brown or pale yellow, laminated; latex white. **Sapwood** pale purple, white or red. **Twigs** with numerous to dense cover of orange-brown to reddish brown stellate hairs. **Leaves** imparipinnate, to 21 cm long; petioles 3–10(–30) cm long; leaflets differing markedly in size, pale yellowish green when dry, below with numerous orange-brown pits; lateral leaflets 1 or 2 on each side of rachis, opposite; blades of basal leaflets subrotund or obovate, 2.5–8 × 1.5–5 cm, with 5–8 lateral veins on each side of midrib and rounded base, that of lateral leaflets obovate, 11–18 × 4.5–6.5 cm and of terminal leaflets obovate, to 29 × 13 cm, both with 10–14(–17) lateral veins on each side of midrib and acute to obtuse base; midrib subprominent and densely covered with orange-brown stellate hairs below; lateral veins subprominent below; intercostal venation faint below; petioles of lateral leaflets to 0.3 cm long, that of terminal leaflets to 1.4 cm long. **Inflorescences** 21–26 cm long, 15–28 cm wide, with numerous to densely packed orange-brown stellate hairs. **Flowers** 0.5–1.2 × 0.5–1.2 mm; calyx with a few orange-brown stellate hairs or scales; petals 5; staminal tube cup-shaped, to 0.5 mm high, margin shallowly lobed, anthers 5, to 0.3 × 0.3 mm; ovary subglobose, densely covered with pale yellow stellate hairs, locule 1, containing 1 ovule, stigma ovoid, pale brown with two minute dark brown apical lobes. **Fruits** indehiscent, locule 1, containing one seed, narrowly ellipsoid, 5.4–6.5 × 2.1–2.5 cm, red when young, yellow when ripe, with a stipe (narrowed region at base of fruit) to 5 mm long and a beak to 5 mm long; pericarp thin and leathery when dry, with 10 longitudinal ridges from base to apex, along two of which the pericarp splits when dry, densely covered with compact reddish brown stellate hairs outside. **Seeds** ellipsoid, 3.6–4.2 × 1.2–1.7 × 0.6–1.0 mm.

Vernacular name. Sabah—*lantupak* (Dusun Kinabatangan).

Distribution. Endemic in Borneo. In Sabah, recorded from Kinabatangan, Kota Kinabalu, Ranau, Sandakan and Tawau districts (e.g., *SAN* 30091, *SAN* 41153, *SAN* 72360, *SAN*

89002 and SAN 93651) and in Sarawak from Kuching district (e.g., S 39858, S 41077 and S 48771). Also occurring in Kalimantan (e.g., McDonald & Ismail 3609) but not yet recorded from Brunei.

Ecology. In mixed dipterocarp forest, at altitudes to 800 m.

57. *Aglaia tenuicaulis* Hiern

(Latin, *tenuis* = slender, *caulis* = stem)

Sect. *Aglaia*

In Hooker f., Fl. Brit. Ind. 1 (1875) 556; King *op. cit.* 76; Ridley *op. cit.* (1922) 408; Pannell *op. cit.* (1989) 226, *op. cit.* (1992) 313, *op. cit.* (1995) 301; Whitmore, Tantra & Sutrisna *op. cit.* 225; Turner *op. cit.* 339; Coode *et al.* (eds.) *op. cit.* 202; Beaman & Anderson *op. cit.* 125. **Lectotype** (Pannell, 1992): Maingay Kew Dist. 335/3, Peninsular Malaysia, ? Penang (K).

Small tree to 15 m tall, to 10 cm diameter, *often unbranched*. **Bark** smooth, pale brown, pale green or grey with minute longitudinal cracks; inner bark pale yellowish brown; without or with white latex. **Sapwood** pale brown or pale pinkish brown. **Twigs** stout, *densely covered with reddish brown stellate hairs*. **Leaves** *imparipinnate*, to 130 cm long; petioles to 25 cm long; *leaflets* coriaceous, dull dark green above, yellowish green below, usually pale green when dry, *below with numerous reddish brown stellate hairs, the hairs sometimes with a few long arms which overlap with those of adjacent hairs but usually with arms all short and not overlapping; lateral leaflets 3–5 on each side of rachis*, alternate or subopposite; *blades elliptical, ovate or obovate, 11–25.5 × 5.5–9 cm*, base cuneate or rounded, margin recurved, apex shortly acuminate, acumen obtuse or acute, to 15 mm long; midrib prominent below; lateral veins 10–19 on each side of midrib, subprominent below; *intercostal venation faint*; petiolules to 2.5 cm long. **Inflorescences** 10–40 cm long, 10–40 cm wide, densely covered with reddish brown stellate hairs. **Flowers** subglobose, 1.2–1.5 × 1.5 mm; *calyx deeply divided into 5 acute lobes*, outside densely covered with brown stellate scales; corolla *c.* 1 × 1–1.1 mm, *petals* 5; staminal tube 0.6–1.5 × 0.9–1.3 mm, anthers ovoid, *c.* 0.3 × 0.25 mm, with a few pale yellow simple hairs at apex; ovary depressed globose, 0.2–0.3 × 0.3–0.6 mm, stigma obovoid, 0.2–0.5 × 0.4 mm, truncate at apex with a lobed margin. **Fruits** *indehiscent, locules 1 or 2*, each containing 1 seed, ellipsoid or subglobose, 1.5–3 × 1.2–2.5 cm; *pericarp outside densely covered with orange-brown or reddish brown stellate, short-armed hairs*, yellow inside. **Seeds** reddish brown, completely surrounded by a translucent, edible, sweet aril.

Distribution. Thailand, Sumatra, Peninsular Malaysia, Singapore, Bunguran Island, Borneo (Brunei, Sabah and Sarawak) and the Philippines (Samar).

Notes. In Borneo, two subspecies, viz. subsp. *tenuicaulis* and subsp. *semengohensis*, are recognised.

Key to subspecies

Small tree to 5 m tall, unbranched or with a few ascending branches. Stellate hairs on lower leaflet surface with arms of different lengths.....

subsp. **tenuicaulis**

Small tree to 5 m tall, to 5 cm diameter; unbranched or with a few ascending branches; latex white. Leaflets with numerous reddish brown stellate hairs on lower surface sometimes with a few long arms which overlap with those of adjacent hairs but usually with arms all short and not overlapping; lateral leaflets 3 or 4 on each side of rachis; blades 11–23 × 5.5–8 cm. Flowers: staminal tube c. 0.6 × 0.9 mm, anthers c. 0.3 × 0.25 mm; ovary c. 0.2 × 0.3 mm, stigma obovoid, c. 0.2 × 0.4 mm, truncate at apex with a lobed margin. Fruits 1.5–3.5 × 3 cm.

Distribution as the species. In Borneo, known in Sabah from Sipitang and Tambunan districts (e.g., *SAN 133228* and *SAN 139449*) and in Sarawak from Betong, Kapit, Lundu, Marudi, Miri and Song districts (e.g., *S 19933*, *S 34828*, *S 34902*, *S 64750* and *S 74020*). Also occurring in Brunei (e.g., *BRUN 496*, *Kirkup DK 887* and *Prance 30559*).

In forest on sandy clay soil, at altitudes to 1000 m.

Tree to 15 m tall, branched. Stellate hairs on lower leaflet surface with arms of even length.....

subsp. **semengohensis** Pannell

(of Semengoh FR, Sarawak)

Kew Bull. 59 (2004) 90. Type: *Pennington 7952*, Borneo, Sarawak, Kuching district, Semengoh FR (holotype FHO; isotype KEP).

Tree to 15 m tall, to 10 cm diameter, branched; without latex. Leaflets with numerous reddish brown stellate hairs with arms of even length not overlapping with those of adjacent hairs; lateral leaflets 4 or 5 on each side of rachis; blades 11.5–25.5 × 5.5–9 cm. Flowers: staminal tube c. 1.5 × 1.3 mm, anthers c. 0.5 × 0.4 mm; ovary c. 0.3 × 0.6 mm, stigma ovoid, c. 0.5 × 0.4 mm. Fruits 1.6–2.3 × 1.2–1.8 cm.

Only known in Sarawak from Semengoh FR, Kuching district (e.g., *Pennington 7952*, *S 15052*, *S 36644*, *S 36991*, *S 40586* and *S 72748*).

In mixed dipterocarp forest on undulating lands and hillsides, at 50–100 m altitude.

58. Aglaia teysmanniana (Miq.) Miq.

(Johannes Elias Teijsmann, 1809–1882; Curator of the Bogor Botanic Gardens, Indonesia)

Sect. **Neoaglaia**

Ann. Mus. Bot. Lugd. Bat. 4 (1868) 48; Pannell *op. cit.* (1989) 226, *op. cit.* (1992) 108, *op. cit.* (1995) 231; Whitmore, Tantra & Sutisna *op. cit.* 225; Turner *op. cit.* 339; Beaman & Anderson *op. cit.* 125.

Basionym: *Amoora teysmanniana* Miq. *op. cit.* (1861) 196, 503. **Lectotype** (Pannell, 1992): *Teysmann HB 4423*, Sumatra, S Lampong, Tarabangi River (U [Acc. No. 39203]; isoelectotypes BO, L [Acc. No. 9081321044 & 9081321064]). **Synonyms:** *Aglaia heptandra* Koord. & Valetton *op. cit.* (1896) 132, *op. cit.* (1913) t. 157, Backer & Bakhuizen *f. op. cit.* 126.

Tree to 20 m tall, to 40 cm diameter, branched; bole with short plank buttresses. **Bark** pale greyish brown or brown with longitudinal cracks and lenticels; inner bark yellowish brown; latex white. **Sapwood** pale yellowish brown. **Twigs** densely covered with pale yellowish brown stellate hairs. **Leaves** imparipinnate, to 60 cm long; petioles to 9.5 cm long; leaflets below densely but not completely covered with pale yellowish brown stellate hairs on the surface and midrib; lateral leaflets 2 or 3 on each side of rachis, usually subopposite, sometimes alternate; blades elliptical or obovate, 5–17.5(–25) × 2.5–7(–9.5) cm, base cuneate or rounded, asymmetrical, margin planar to slightly recurved, apex acuminate or

shortly caudate, acumen obtuse or acute, to 15 mm long; midrib prominent below; *lateral veins 8–16 on each side of midrib*, subprominent below; *intercostal venation faint*; *petiolules 1–2 cm long*. **Inflorescences** to 15 cm long and wide, with numerous pale yellowish brown stellate short-armed hairs or scales. **Flowers** *c.* 2.2 × 2.2 mm; *calyx shallowly divided into 3 or 5 rounded lobes*, densely covered with scales like those on the twigs; *petals 3 or 5*; *staminal tube cup-shaped*, *c.* 1.1 × 1.3 mm, anthers 7 or 8, *c.* 0.3 × 0.3 mm; *ovary* subglobose, *c.* 0.4 × 0.6 mm, densely covered with stellate scales, *locules 3*, stigma *c.* 0.2 × 0.3 mm with three small apical lobes. **Fruits** subglobose, 1–2.2 × 1.3–2 cm, 3-locular, *dehiscing into 3 lobes when ripe*; pericarp *c.* 2 mm thick, white, turning pink on exposure to air, densely covered with pale brown stellate scales, containing some latex, innermost layer in each locule a detachable membrane surrounding the seed. **Seeds** 1–3, obovoid, (0.7–)1.1–1.4 × (0.4–)0.6–0.9 cm; aril orange or red.

Vernacular names. Sabah—*bibilad* (Malay), *malangsats* (Bajau), *mumutah* (Dusun).

Distribution. China, Thailand, Sumatra, Peninsular Malaysia, Borneo, the Philippines, Java and Sulawesi. In Sabah, recorded from Lahad Datu, Ranau and Semporna districts (e.g., *SAN 31507*, *SAN 42715*, *SAN 76757*, *SAN 135304* and *SPN 7275*) and in Sarawak from Kuching, Lawas and Lundu districts (e.g., *S 21844*, *S 31145*, *S 40238*, *S 49880* and *S 96531*). Also occurring in Kalimantan (e.g., *Leighton 793*) but not yet recorded from Brunei.

Ecology. In mixed dipterocarp and riparian forests, including on sandy alluvial soil, at altitudes to 1650 m. In Peninsular Malaysia, the seeds are eaten and thought to be dispersed by barbets (Capitonidae), broadbills (Eurylaimidae) and bulbuls (Pycnonotidae).

59. *Aglaia tomentosa* Teijsm. & Binn.

Fig. 10, Plate 4C.

(Latin, *tomentosus* = thickly and evenly covered with hairs)

Sect. *Aglaia*

Nat. Tijdschr. Ned. Ind. 27 (1864) 43; Pannell *op. cit.* (1989) 226, *op. cit.* (1992) 331, *op. cit.* (1995) 306; Whitmore, Tantra & Sutisna *op. cit.* 225; Kessler & Sidiyasa *op. cit.* 168; PROSEA *op. cit.* (1995) 54; Turner *op. cit.* 339; Coode *et al.* (eds.) *op. cit.* 202; Beaman & Anderson *op. cit.* 125. **Lectotype** (Pannell, 1992): *Teysmann s.n.*, Sumatra, Bangka Island, Plangas Djeboes (BO). **Synonyms:** *Argophilum pinnatum* Blanco, Fl. Filip. ed. 1 (1837) 186; *Aglaia rufa* Miq. *op. cit.* (1868) 49; *Aglaia dyeri* Koord. *op. cit.* 634; *Aglaia glomerata* Merr. *op. cit.* (1906) 30, *op. cit.* (1921) 323; *Aglaia pinnata* (Blanco) Merr. *op. cit.* (1918) 212, *non* Druce (1914); *Aglaia kabaensis* Baker *f.*, J. Bot. London 62, Suppl. (1924) 19; *Aglaia cordata* Hiern *op. cit.* 557, King *op. cit.* 73, *p.p.*, Ridley *op. cit.* (1922) 409, *p.p.*, Pannell *op. cit.* (1989) 214. (For further synonyms *cf.* Pannell *op. cit.* 1992 & *op. cit.* 1995.)

Tree, 9–20 m tall, 10–25 cm diameter, *branched*; often flowering and fruiting at 1.5–2.5 m tall. **Bark** pale reddish brown or grey with green patches, with longitudinal cracks and lenticels arranged in longitudinal rows; inner bark yellow, fibrous or granular; latex white. **Sapwood** pale brown or pinkish brown. **Twigs** slender, *densely covered with reddish brown or orange-brown stellate hairs with arms to 1 mm long*. **Leaves** *imparipinnate*, to 60 cm long; petioles to 13 cm long; *leaflets with hairs like that of the twigs either few or dense on the midrib above or numerous to dense on the midrib, lateral veins and surface of the blade below*; *lateral leaflets 2–5 (rarely 6) on each side of rachis*, opposite or subopposite; *blades obovate, elliptical or narrowly elliptical, 1.7–23 × 0.8–11.5 cm*, base rounded, cordate or

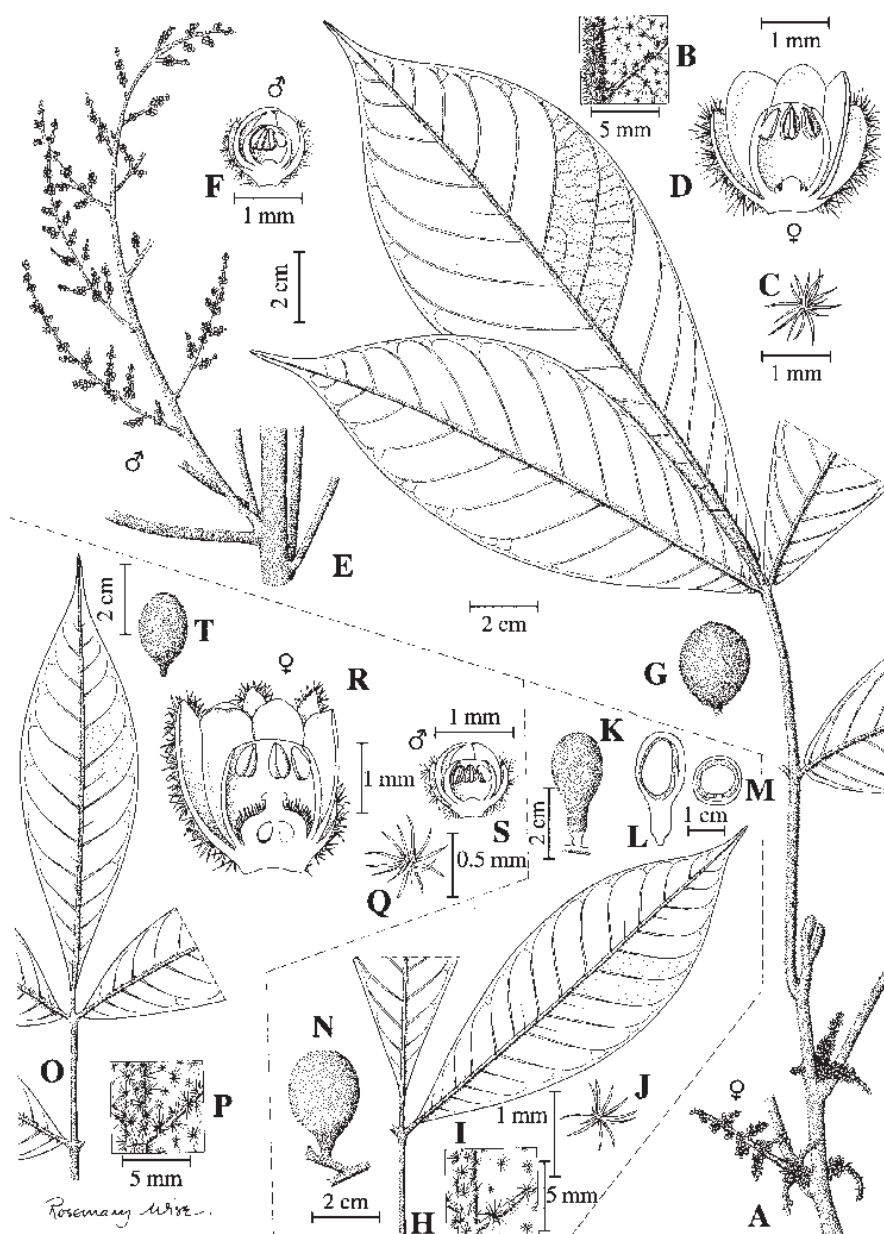


Fig. 10. *Aglaia tomentosa*, subsp. *cordata* (A–G), subsp. *kabaensis* (H–N), subsp. *tomentosa* (O–T). A, leafy twig with female inflorescences; B, detail of midrib and lateral vein on the lower leaflet surface showing the indumentum; C, stellate hair; D, longitudinal section of female flower; E, male inflorescence; F, longitudinal section of male flower; G, fruit; H, distal part of leaf; I, detail of midrib and lateral vein on the lower leaflet surface showing the indumentum; J, stellate hair; K, young fruit; L, longitudinal section of young fruit; M, cross-section of young fruit; N, mature fruit; O, distal portion of leaf; P, detail of midrib and lateral vein on lower leaflet surface showing indumentum; Q, stellate hair; R, longitudinal section of female flower; S, longitudinal section of male flower; T, fruit. (A–D from S 42630, E–F from SAN 79063, G from SAN 64755; H–J from SAN 94273, K–M from Pennington 7947, N from SAN 94273; O–Q from SAN 90238, R from S 32216, S from SAN 94577, T from SAN 81143.)

tapering and cuneate, asymmetrical, margin sometimes recurved, apex acuminate or caudate, acumens obtuse or acute, to 35 mm long; midrib prominent below; *lateral veins* 5–19 on each

side of midrib, subprominent below; *intercostal venation* visible but faint below; petiolules 0–2 cm long. **Inflorescences** densely covered with stellate hairs like that of the twigs; males 9–18 cm long, 3–22 cm wide; females smaller, with fewer branches. **Flowers** subglobose, 1–2.3 mm diameter, sessile; *calyx* outside densely covered with stellate hairs, *deeply divided into 5 acute or obtuse lobes with ciliate margins*; *petals* 5, white or yellow, glabrous; staminal tube cup-shaped or subglobose, apical margin slightly incurved and shallowly 5-lobed, *anthers* 5, broadly ovoid, 0.2–0.4 × 0.1–0.3 mm; ovary 0.1–0.5 × 0.3–0.9 mm, locules 2, each containing 1 ovule, stigma ovoid, 0.2–0.5 mm across. **Fruits** indehiscent, *locules* 2, each containing 0 or 1 seed, subglobose, obovoid or pear-shaped, 1.6–3 × 1.2–2.2 cm, with dense indumentum like that of twigs, sometimes glabrescent; *pericarp* brittle, less than 2 mm thick; stalk to 7 mm long. **Seeds** with brown testa; aril orange, red or brown, gelatinous, translucent, acidic-tasting, completely covering the seed.

Vernacular names. Sabah—*langsats monyet* (Malay), *lantupak* (Dusun Kinabatangan). Sarawak—*punyau* (Punan), *segera* (Iban).

Distribution. S India, Vietnam, Laos, Thailand, Sumatra, Peninsular Malaysia, Singapore, Borneo, the Philippines, Sulawesi, Nusa Tenggara (Flores), New Guinea and Australia.

Ecology. In evergreen forests at altitudes to 2000 m. Fruits are eaten and seeds are probably dispersed by monkeys.

Notes. In Borneo, three subspecies, viz. subsp. *cordata*, subsp. *kabaensis* and subsp. *tomentosa* are recognised.

Key to subspecies

1. Lower leaflet surface with few hairs. Fruits pear-shaped.....
 subsp. **kabaensis** (Baker f.) Pannell Fig. 10H–N.
 (of Kaba volcano in Palembang, Sumatra)
 Kew Bull. 59 (2004) 91; Beaman & Anderson *op. cit.* 126. Basionym: *Aglaia kabaensis* Baker f. *op. cit.* 19. Lectotype (Pannell, 1992): *Forbes s.n.*, Sumatra, Palembang, foot of Kaba volcano (BM; isoelectotypes K, L [Acc. Nos. 9081411382 and 908143169]).
 Leaflets pale green or pale brown when dry, venation pale yellow or pale brown, lower surface with a few compact orange-brown stellate hairs and few to numerous pale yellow or white stellate scales in between; blades 4.5–23 × 1.8–8 cm, base rounded or cuneate; lateral veins 7–19 on each side of midrib; petiolules 0.5–2 cm long. Flower c. 1.2 × 1 mm. *Fruits pear-shaped*, to 3 × 1.8 cm.
 Sumatra, Peninsular Malaysia and Borneo. In Sabah, common and known from Keningau, Kinabatangan, Kota Merudu, Lahad Datu, Ranau, Sandakan, Tawau and Tenom districts (e.g., SAN 71024, 76891, SAN 78268, SAN 80096 and SAN 94273). In Sarawak rare, known only from a single collection (*Clemens* 6708) from Mt. Poi. Also occurring in Kalimantan (e.g., *Church et al.* 759 and *Church et al.* 1213) but not yet recorded from Brunei.
 Hairs numerous on lower leaflet surface, the arms of the stellate hairs usually overlapping. Fruits subglobose or obovoid2

2. Leaflet base rounded or cuneate Fig. 100–T.
 subsp. **tomentosa**
 Pannell, Kew Bull. 59 (2004) 91; Beaman & Anderson *op. cit.* 125. Synonyms: *Argophilum pinnatum* Blanco *op. cit.* 186; *Aglaia rufa* Miq. *op. cit.* (1868) 49, Merrill *op. cit.* (1921) 323, Masamune *op. cit.* 373; *Aglaia dyeri* Koord. *op. cit.* 634; *Aglaia glomerata* Merr. *op. cit.* (1906) 30; *Aglaia pinnata* (Blanco) Merr. *op. cit.* (1918) 212, Anderson *op. cit.* (1980) 249.
Leaflets with hairs like that of the twigs numerous to dense on the midrib and veins and numerous on the rest of the lower surface, with the arms of adjacent hairs overlapping or not, with smaller paler hairs which have fewer and shorter arms interspersed on the surface in between; blades 1.7–16 × 0.8–11.5 cm, often recurved at the margin when dry, tapering to a rounded or cuneate base. Flowers 1.3–1.9 × 1.1–2.3 mm. Fruits subglobose, 1.6–2.4 × 1.2–2.2 cm.
 Distribution as the species. In Sabah and Sarawak common; in Sabah recorded from Beaufort, Kalabakan, Keningau, Kota Belud, Kota Kinabalu, Lahad Datu, Nabawan, Pensiangan, Ranau, Sandakan and Tawau districts (e.g., *SAN 39042*, *SAN 81143*, *SAN 87037*, *SAN 89808* and *SAN 91071*) and in Sarawak from Baram, Belaga, Kapit, Kuching, Limbang, Lubok Antu, Marudi, Miri and Tubau districts (e.g., *S 24820*, *S 34988*, *S 35608*, *S 42389* and *S 61153*). Also occurring in Brunei (e.g., *Coode 7929*, *Dransfield JD 6844*, *Kirkup DK 537*, *Sands 5903* and *Wong WKM 646*) and Kalimantan (e.g., *Ambriansyah et al. AA 1206*, *Burley et al. 804*, *Kessler et al. PK 1355*, *Laman et al. 1054* and *Veldkamp 8067*).
- Leaflet base cordate Fig. 10A–G.
 subsp. **cordata** (Hiern) Pannell
 (Latin, *cordatus* = heart-shaped; the base of leaflets)
 Kew Bull. 59 (2004) 91; Beaman & Anderson *op. cit.* 126. Basionym: *Aglaia cordata* Hiern *op. cit.* 557, King *op. cit.* 73, *p.p.*, Merrill *op. cit.* (1921) 322, Ridley *op. cit.* (1922) 409, *p.p.*, Merrill *op. cit.* (1929) 124, Masamune *op. cit.* 371, Anderson *op. cit.* (1980) 247, Pannell *op. cit.* (1989) 213, Whitmore, Tantra & Sutisna *op. cit.* 221. Lectotype (Pannell, 1992): *Maingay 2969* (= *Kew Dist. 335/2*), Peninsular Malaysia, Malacca (K).
Leaflet lower surface with numerous reddish brown or pale orange-brown stellate hairs with arms to 0.5 mm long, those of adjacent hairs usually overlapping, interspersed with smaller paler hairs with fewer arms in between, usually sessile; blades 5.3–22 × 2.5–11, base cordate. Flowers 1–2.3 × 1.2–3 mm. Fruits subglobose, to 2.1 × 2.2 cm.
 Thailand, Sumatra, Peninsular Malaysia, Singapore, Anambas Islands, Java, Borneo and the Philippines. In Sabah, known from Beaufort, Kinabatangan, Kuala Penyu, Kudat, Sandakan and Tawau districts (e.g., *SAN 63249*, *SAN 64755*, *SAN 72246*, *SAN 78680* and *SAN 91802*) and in Sarawak from Belaga, Kapit, Lubok Antu, Miri, Marudi and Serian districts (e.g., *S 27647*, *S 36802*, *S 16532*, *S 39477* and *S 87184*). Also occurring in Brunei (e.g., *BRUN 15239*, *BRUN 15618*, *BRUN 17502*, *Sands 5829* and *Wong WKM 851*) and Kalimantan (e.g., *Burley et al. 3216*, *Church et al. 218*, *Hansen 1342* and *Kessler et al. PK 1071*).

60. *Aglaia variisquama* Pannell (Latin, *varius* = various, *squama* = scale)

Sect. *Aglaia*

Kew Bull. Add. Ser. 16 (1992) 153, *op. cit.* (1995) 245; Turner *op. cit.* 339. **Type:** *Tong S 34271*, Borneo, Sarawak, Sabal Tapang FR (holotype FHO; isotypes KEP, L, SAR).

Tree to 20 m tall, to 30 cm diameter, branched. **Bark** smooth, green, brown, reddish grey or black; inner bark pale yellow or red. **Sapwood** pale yellow. **Twigs** densely covered with dark orange-brown peltate scales to 0.3 mm diameter and with an irregular margin, interspersed with some scales with dark orange-brown centres and paler margins. **Leaves** imparipinnate, to 79 cm long; petioles 7–15 cm long; leaflets coriaceous, slightly asymmetrical, lower surface with numerous scales like that of the twigs, the scales evenly distributed and usually visible to the naked eye as tiny dark and pale brown spots; lateral leaflets 4–6 on each side of rachis, subopposite, terminal ones not folded at the base; blades obovate, 7.5–30 × 4–13 cm, base cuneate, margin recurved, apex acuminate, acumen obtuse, to 5 mm long; midrib impressed above, prominent below; lateral veins 10–17 on each side of midrib, subprominent below; intercostal venation inconspicuous on both surfaces; petiolules 0.5–1.9 cm long. **Inflorescences** to 32 cm long, to 22 cm wide, densely covered with scales like that of the twigs. **Flowers** depressed globose, 1.5–3 × 2–4 mm; calyx c. 0.5 mm long, divided into 5 subrotund lobes, with numerous pale peltate, fimbriate scales; petals 5 or 6, yellow or white; staminal tube depressed globose, 1.2–1.8 × 1.5–2 mm, anthers 5, c. 0.6 × 0.4 mm, with a few simple hairs at the base and apex; ovary depressed globose, 0.2–0.6 × 0.6–0.9 mm, densely covered with pale orange-brown peltate fimbriate scales, locules 1 or 2, each containing 1 or 2 ovules, stigma ovoid, c. 0.7 × 0.8 mm. **Fruits** indehiscent, locules 1 or 2, subglobose, c. 4 × 4 cm, sometimes with a small beak, yellowish brown, outside densely covered with pale orange-brown peltate scales; latex white. **Seed** 1, with a fleshy translucent aril; testa dark brown.

Vernacular names. Sabah—*lantupak* (Dusun Kinabatangan). Sarawak—*segera* (Iban).

Distribution. Peninsular Malaysia and Borneo. In Sabah, recorded from Kinabatangan, Lahad Datu, Sandakan and Tawau districts (e.g., *Kokawa & Hotta 1501*, *SAN 40869*, *SAN 46062*, *SAN 79205* and *SAN 80967*) and in Sarawak from Belaga, Bintulu, Kuching, Lundu, Mukah, Serian and Simunjan districts (e.g., *Burley & Lee 251*, *S 34271*, *S 34303*, *S 35640* and *S 77370*). Also occurring in Kalimantan (e.g., *Kostermans 9811*). Not yet recorded from Brunei.

Ecology. In mixed dipterocarp, *kerangas*, and swamp forests, at altitudes to 950 m.

2. APHANAMIXIS Blume

(Greek, *aphanos* = invisible, *mixis* = mating;
an allusion to the sex organs enclosed in the staminal tube)

lantupak (Dusun), *segera* (Iban), *segera* (Malay)

Bijdr. Fl. Ned. Ind. (1825) 165; Ridley, FMP 1 (1922) 400; Masamune, EPB (1942) 374; Pennington & Styles, Blumea 12 (1975) 485; Anderson, CLTS (1980) 250; Mabberley, Blumea 31 (1985) 136, in Mabberley & Pannell, TFM 4 (1989) 230, PB 2nd. ed. (1997) 46; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 226; Mabberley *et al.*, FM 1, 12 (1995) 187; Coode *et al.* (eds.), CLBD (1996) 202; Argent *et al.* (eds.), MNDT-CK 2 (1997) 412; PROSEA 5, 3 (1998) 78; Beaman & Anderson, PMK 5 (2004) 126. **Synonyms:** *Amoora* Roxb. sect. *Aphanamixis* (Blume) C.DC. in A.P. de Candolle, Mon. Phan. 1 (1878) 579; ?*Ricinocarpodendron* Boehm. in Ludwig, Defin. Gen. Pl. ed. 3 (1760) 512. (For complete synonymy cf. Mabberley *op. cit.* 1985.)

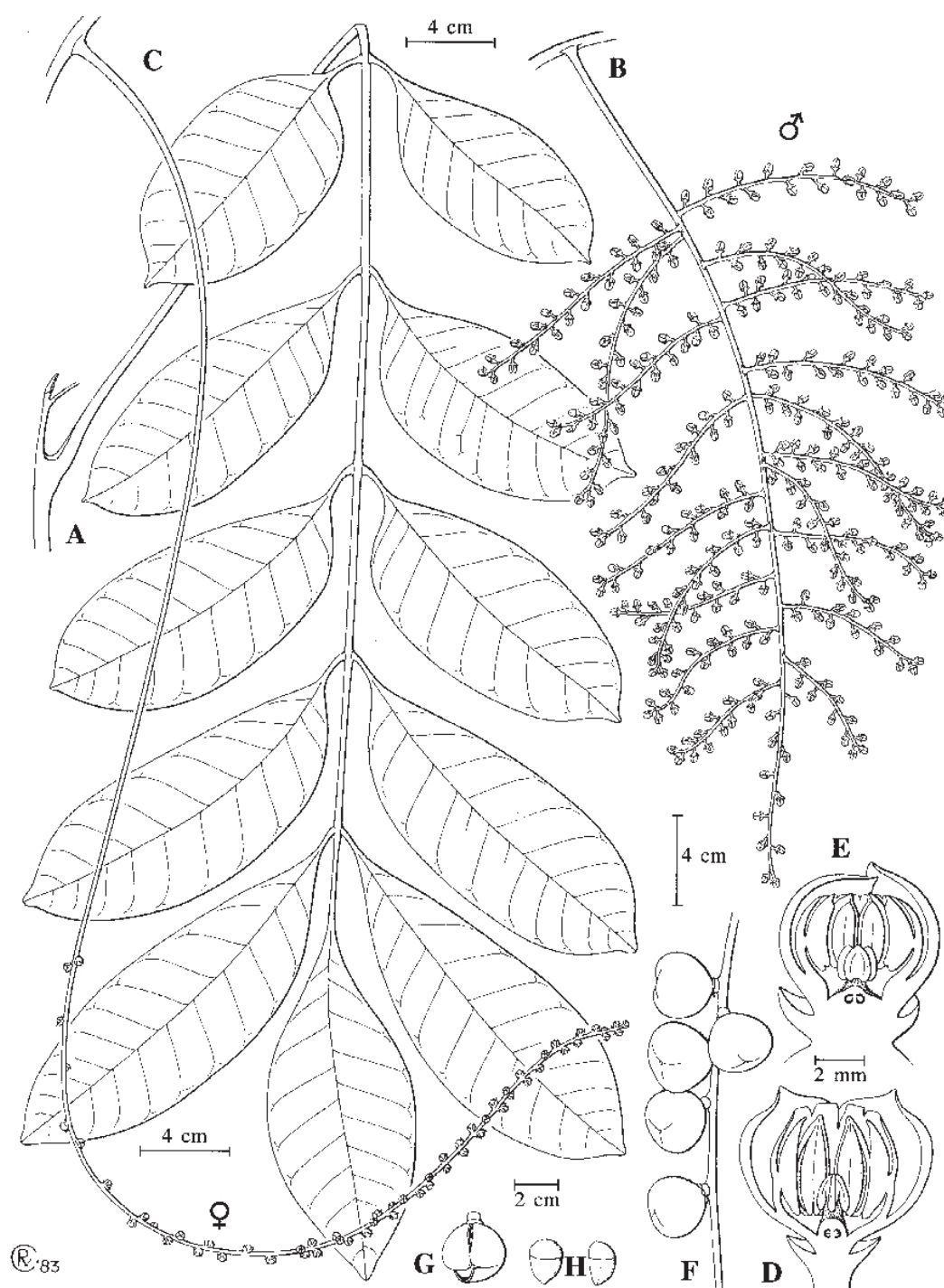


Fig. 11. *Aphanamixis borneensis*. A, leafy apical shoot; B, male inflorescence; C, female inflorescence; D, longitudinal section of male flower; E, longitudinal section of female flower; F, part of infructescence; G, dehiscing fruit; H, seeds. (Reproduced with permission and minor modification from FMI, 12 (1995): Fig. 29, p. 192; A from *Bianchi* 35, B from *SAN* 61233, C from *SAN* 26412, D from *Mabberley* 1706, E from *Clemens* 30483, F–H from *S* 13657.)

Trees or pachycaul treelets. **Twigs** with distinct petiole scars. **Indumentum** of simple (rarely basally bifid and stellate) hairs. **Bud scales** absent. **Leaves** imparipinnate, without pseudogemmula; lateral leaflets 3–10 on each side of rachis, opposite. **Inflorescences** axillary to supra-axillary panicles (males), or spikes, racemes or rarely panicles (females, bisexuals). **Flowers:** males smaller than females or bisexuals; calyx deeply 5-lobed, lobes imbricate; *petals* 3, imbricate, united with staminal tube basally; staminal tube globose to deeply cup-shaped, anthers 6 (or 8), glabrous, inserted within tube; *disc* absent; ovary 3(or 4)-locular, each locule with (1 or) 2 collateral to superposed ovules; style stout, stylehead conical to truncate, 3-angled or with impressions of anthers. **Fruit** a 2- or 3(or 4)-valved, loculicidal capsule, each locule with 1 or 2 seeds. **Seeds** arillate; embryo with planoconvex, collaterally(?) united cotyledons; radicle small, superior, included. Germination cryptocotylar; eophylls opposite, simple, toothed.

Distribution. Three very closely related species in Indo-Malesia from Sri Lanka and India to Bhutan, tropical China and Indo-China, throughout Malesia, to the Solomon Islands. In Sabah and Sarawak, two species are recorded.

Notes. All three species were originally referred to *Andersonia* Roxb. or *Amoora* Roxb. (i.e. *Aglaia* Lour.), to which *Aphanamixis* is very closely related. Except for the apparent unity of the cotyledons (a feature not investigated in all *Aglaia* spp. so far), there is no other macroscopic character that separates them absolutely. At the microscopic level, only one *Aglaia* sp. examined has the 4-colporate pollen grains found in *Aphanamixis* and the wood of the latter differs from that of the *Aglaia* species formerly included in *Amoora* in having confluent and banded paratracheal parenchyma.

Key to *Aphanamixis* species

Lateral veins conspicuously looped well clear of margin; petiolules 1.5–3 cm long, the terminal ones to 4.5 cm long.....1. ***A. borneensis***
 Lateral veins not so; petiolules 0.4–1 cm long, the terminal ones to 1.5 cm long.....
2. ***A. polystachya***

1. *Aphanamixis borneensis* (Miq.) Harms (from Borneo)

Fig. 11, Plate 5A.

In Engler & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 296; Merrill, EB (1921) 321; Masamune *op. cit.* 374; Anderson *op. cit.* (1980) 250; Mabberley *op. cit.* (1985) 138; Whitmore, Tantra & Sutisna *op. cit.* 226; Mabberley *et al. op. cit.* 193; Coode *et al. (eds.) op. cit.* 202; Beaman & Anderson *op. cit.* 126. **Basionym:** *Amoora borneensis* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 36. **Lectotype** (here designated): *Korthals s.n.*, Borneo, Kalimantan, Mt. Prarawin (U; ?isolectotype L [Acc. No. 9081321611]). **Synonyms:** *Aphanamixis sumatrana auct. non* Harms (1896); Merrill, PEB (1929) 123; *Aphanamixis pedicellata* Ridl., Bull. Misc. Inform. Kew (1930) 370, Anderson *op. cit.* (1980) 250; *Walsura punctata* Süss. var. *papillosa* Süss. & Heine, Mitt. Bot. Staats. Münch. 2 (1950) 59; *Ricinocarpodendron borneense* (Miq.) Mabb., Mal. For. 45 (1982) 454.

Tree to 13.5 m tall, to 15 cm diameter. **Bark** reddish; inner bark orangeish-mottled, soft, with watery latex. **Sapwood** orange. **Twigs** 5–10 mm diameter apically, greyish. **Leaves** 30–80 cm long; petioles 15–18 cm long, c. 5 mm diameter, terete, puberulous, flattened to

grooved or hollowed adaxially at base, the groove appressed fulvous-pubescent; leaflets coriaceous (particularly at high altitudes), glabrous; lateral leaflets 3–8 on each side of rachis; blades lanceolate to narrowly elliptical-oblong or oblanceolate, 7–25 × 4–7.5 cm, base acute to attenuate, weakly asymmetrical, margin recurved, apex acute to cuspidate or acuminate, acumen to 15 mm long; midrib prominent below, subprominent above; *lateral veins* 9–12 on each side of midrib, *conspicuously looped well clear of margin*, often prominent below, faint above; intercostal venation reticulate; *petiolules* 1.5–3 cm long, *the terminal ones to 4.5 cm long*, swollen at base. **Inflorescences** to 65 cm long; males with subsquarrose (= somewhat projecting outwards at an angle of *c.* 90°) branches to 15 cm long, strongly supra-axillary; axes puberulous. **Flowers** 5–7 mm diameter; bracteoles scale-like *c.* 0.5 mm; pedicels 0–1 mm long in females, 3–6 mm long in males; calyx lobes 4–5 mm across, subrotund to erose (= irregularly toothed), pubescent outside, pinkish, margin glandular-ciliate; petals 5–7 mm long, subrotund, glabrous, creamy-white or pinkish; staminal tube with small pore, anthers 6, narrowly oblong, *c.* 3 mm long, glabrous. **Fruits** borne towards tip of axis, 3–4 cm diameter, glabrous, pink to dark red, white inside. **Seeds** 1–3, *c.* 18 × 12 mm, planoconvex, covered with vermilion aril; testa dark brown to black.

Distribution. Borneo, the Philippines (Palawan) and Maluku (Halmahera). In Borneo, recorded in Sabah from Beaufort, Keningau, Kinabatangan, Kota Marudu, Lahad Datu, Penampang, Pitas, Ranau, Sandakan, Sipitang, Tambunan and Tawau districts (e.g., *Mabberley 1691*, *Pereira 745*, *SAN 39900*, *SAN 80312* and *SAN 131356*) and in Sarawak from Bau, Belaga, Kapit and Marudi districts (e.g., *S 46907*, *S 48266*, *S 72968* and *S 81303*). Also occurring in Brunei (e.g., *S 5802* and *Johns et al. 7598*) and Kalimantan (e.g., *Veldkamp 8130* and *Veldkamp 8479*).

Ecology. Common small tree of lowland, hill and lower montane forests and heath forest at altitudes to 1800 m.

Notes. It has been confused with *Aphanamixis sumatrana* (Miq.) Ridl. (Sumatra and Peninsular Malaysia) because of similarities in the leaflets, but that species is unique in the flower having only three anthers.

2. *Aphanamixis polystachya* (Wall.) R.N.Parker

(Greek, *poly-* = many, *stachys* = branch; referring to the much-branched male inflorescence)

Ind. For. 57 (1931) 486; Anderson *op. cit.* (1980) 250; Mabberley *op. cit.* (1985) 136, *op. cit.* (1989) 230; Whitmore, Tantra & Sutisna *op. cit.* 227; Mabberley *et al. op. cit.* 188; Turner, Gard. Bull. Sing. 47 (1995) 339; Coode *et al. (eds.) op. cit.* 203; Argent *et al. (eds.) op. cit.* 413. **Basionym:** *Aglaia ?polystachya* Wall. in Roxb., Fl. Ind. 2 (1824) 429. **Type:** *de Silva in EIC 1277* (holotype K-W; isotypes G-DC, K). **Synonym:** *Ricinocarpodendron polystachyum* (Wall.) Mabb. *op. cit.* (1982) 454; *Aphanamixis rohituka auct. non* (Roxb.) Pierre (1895); Anderson *op. cit.* (1980) 250. (For further synonyms *cf.* Mabberley *et al. op. cit.* 1995.)

Pachycaul treelet or tree to 20(–35) m tall, often flowering when very small; bole to 70 cm diameter, often crooked, sometimes with buttresses to 1(–2) m tall. **Bark** reddish brown, flaking; inner bark pinkish, often with white latex. **Sapwood** white; heartwood pink. **Twigs** 7–22 mm diameter apically, lenticellate, sometimes myrmecophilous, subglabrous to finely fulvous-tomentellous. **Leaves** 45–125 cm long, red when young, glabrous or less often with petiole, rachis and lower surface of leaflets and upper surface of lateral veins more or less brown pubescent, the hairs simple, basally bifid or stellate; petioles 5–15 cm, 6–9 mm

diameter, more or less lenticellate, terete but greatly swollen and flattened or channelled adaxially near base; leaflets subcoriaceous; lateral leaflets (4–)6–10 on each side of rachis; blades oblong to elliptical-oblong, 7.5–25 × 4–9 cm, base rounded to acute or attenuate, usually markedly asymmetrical, margin planar to slightly recurved, apex cuspidate; midrib prominent on both surfaces; *lateral veins* 10–12 on each side of midrib, *spreading*; intercostal venation sometimes subprominent in dry leaflets; *petiolules* 0.4–1 cm long, *the terminal ones to 1.5 cm long*, swollen. **Inflorescences** to 110 cm long in females, to 50 cm long in males and bisexuals, but often very much shorter, more or less supra-axillary; branches to 15 cm long, squarrose; axes more or less puberulous or pubescent. **Flowers** 4–9 mm diameter, sweetly scented; pedicels 0–4(–8) mm long; bracteoles scale-like, *c.* 0.5 mm; calyx lobes 2–3 mm across, subrotund, more or less pubescent outside, reddish margin ciliate; petals 3–5(–7) mm across, subrotund, more or less pubescent outside, glabrous inside, cream to yellow or bronze, sometimes tinged red, waxy; staminal tube cream, anthers (5 or) 6 (or 8), 2.5–4 mm long, elliptical, apiculate, glabrous. **Infructescences** spicate, very rarely paniculate. **Fruits** 2–4 cm diameter, yellowish at first, pink or red at maturity, glabrous; pericarp sometimes with white latex, white inside. **Seeds** 1–3, 1.7–2.2 cm long, planoconvex, hanging by strips of endocarp from fruit, more or less covered with brownish red or orange oily aril; testa dark brown or black.

Distribution. As for genus. In Borneo, known in Sabah from Keningau, Kota Kinabalu, Kota Marudu, Kuala Penyu, Lahad Datu, Ranau, Sandakan and Tawau districts (e.g., *SAN 39140*, *SAN 39900* and *SAN 142369*) and in Sarawak from Belaga, Kapit, Lundu, Serian and Sri Aman districts (e.g., *Mabberley 1642*, *S 36072*, *S 49253*, *S 65082* and *S 76869*). Also occurs in Brunei (e.g., *Coode et al. 6609*) and Kalimantan (e.g., *Endert 2966*).

Ecology. Lowland and hill forest at altitudes to 1400 m, including seasonally flooded forest and forest on limestone.

Uses. The timber is used in house construction in New Guinea and Thailand and is suitable for furniture. In India, a commercially valuable oil for soapmaking is extracted from the seeds (43.5% by weight) and this, like the bark, has some medicinal value, the latter in a liniment used in the treatment of rheumatism. In Maluku (C Halmahera), the mashed leaves in a water solution are sprayed on fruiting heads of rice against disease and research in China and Bangladesh has shown extracts from twigs, bark, fruits and seeds to be efficacious antifeedants, deterring a range of insect pests.

Notes. This is a polymorphic species across its range but is relatively uniform in Borneo.

3. AZADIRACHTA A.Juss.

(Latinised form of the Persianised Indian name, *azad-dirakht*, for neem, *Azadirachta indica*)

Bull. Sci. Nat. Géol. 23 (1830) 236; Jacobs, Gard. Bull. Sing. 18 (1961) 71; Backer & Bakhuizen *f.*, FJ 2 (1965) 120; Pennington & Styles, Blumea 22 (1975) 464; Anderson, CLTS (1980) 250; Mabberley *in* Mabberley & Pannell, TFM 4 (1989) 231, PB 2nd. ed. (1997) 70; Whitmore, Tantra & Sutisna CLK (1990) 227; Mabberley *et al.*, FM 1, 12 (1995) 337; PROSEA 5, 2 (1995) 72; Coode *et al.* (eds.), CLBD (1996) 203; Argent *et al.* (eds.), MNDT-CK 2 (1997) 413. **Synonym:** *Antelaea auct. non* Gaertn. (1788); Adelbert, Blumea 6 (1948) 315.

Trees. **Indumentum** of simple hairs. **Buds** thinly encrusted with resin; *scales absent*. **Leaves** *paripinnate or imparipinnate* with 2 pairs of glands at base of petioles, *without pseudogemmula*; lateral leaflets 4–10 on each side of rachis, opposite or subopposite. **Inflorescences** thyrsoid, axillary. **Flowers** bisexual and male on same individual (polygamous); calyx 5-lobed to halfway, the lobes imbricate; *petals* 5, free, imbricate; staminal tube cylindrical, slightly expanded at mouth, margin (8–)10-lobed, the lobes rounded, truncate, emarginate or bifid, anthers (8–)10, glabrous, inserted at base of and opposite lobes; *disc annular, united with base of ovary*; ovary 3-locular, each locule with 2 collateral ovules, *stylehead with apical swollen torus with 3 acute, partially united papillose stigmatic lobes*. **Fruit** a 1(or 2)-seeded drupe; endocarp thin, cartilaginous. **Seeds** ovoid, distally pointed; testa thin, membranous with small adaxial sarcotesta; endosperm very thin; embryo with planoconvex, collateral cotyledons; radicle superior, short projecting from cotyledons. Germination phanerocotylar; eophylls opposite, trifoliate, leaflets deeply incised or pinnatifid.

Distribution. Two species native to Indo-Malesia, though one, *A. indica* A.Juss., the *neem*, perhaps native in Myanmar, is widely cultivated in warm countries throughout the world and naturalised in some of them.

Ecology. Lowland forest of various types, *Azadirachta indica* also colonising deforested land.

Notes. Formerly confused with *Melia* L., *Azadirachta* differs in its simple indumentum, pinnate leaves, collateral ovules, 3-lobed stylehead and 1(or 2)-seeded drupes.

Key to *Azadirachta* species

- Leaflets with entire margin (native).....**A. excelsa**
 Leaflets with serrate margin (planted).....

A. indica A.Juss.

Mém. Mus. Nat. Hist. Nat. Paris 19 (1832) 221; Backer & Bakhuizen *f. op. cit.* 120; Radwanski & Wickens, Econ. Bot. 35 (1981) 398; Tewari, Monogr. Neem (1992); Mabberley *et al. op. cit.* 341; PROSEA *op. cit.* (1995) 77. Synonyms: *Melia azadirachta* L., Sp. Pl. (1753) 385, Ridley, FMP 1 (1922) 384; *M. indica* (A. Juss.) Brandis, For. Fl. NW & C India (1874) 67, *nom. illeg.*, Corner, WTM 3rd. ed. 2 (1988) 504.

Tree to 16 m tall. Inflorescences to 30 cm long. Fruits 1–2 cm long. Planted (*neem*) and seeding about (as in Kuching) in the Tree Flora area.

Notes. Azadirachtin is absorbed by plants and acts as a systemic insecticide so efficient that Japanese beetles and other insects, even including the desert locust, will starve rather than eat plants treated with it. Of the five limonoids known from the tree, deacetylaxadirachtin (salannin) is as potent as azadirachtin in inhibiting ecdysis in tobacco budworm. Neem seed powder with carbofuran greatly reduces leaf-hoppers and rice tungro virus in rice. The leaves, bark and seed oil have been used in the treatment of a wide range of ailments, including malaria, eczema, dysentery and ulcers, but particularly effective as a parasiticide for skin diseases such as scabies. Neem oil also has significant post-coital contraceptive action.

Azadirachta excelsa (Jack) Jacobs

Fig. 12.

(Latin, *excelsus* = tall)

Gard. Bull. Sing. 18 (1961) 75; Anderson *op. cit.* (1980) 250; Mabberley *op. cit.* (1989) 233; Whitmore, Tantra & Sutisna *op. cit.* 227; Mabberley *et al. op. cit.* 337; PROSEA 5, 2 (1995) 77; Turner, Gard. Bull. Sing. 47 (1995) 339; Coode *et al. (eds.) op. cit.* 203; Argent *et al. (eds.) op. cit.* 413. **Basionym:** *Melia excelsa* Jack, Mal. Misc. 1, 1 (1820) 12; Corner, Gard. Bull. Str. Sett. 10 (1939) 263, *op. cit.* (1988) 504; Corner & Watanabe, Ill. Guide Trop. Pl. (1969) 404. **Type:** *Jack s.n.*, Peninsular Malaysia, Penang (holotype[†]; isotypes E, K-W [*'178' in EIC 1253b*]). **Synonyms:** *Trichilia excelsa* (Jack) Spreng., Syst. 4, 2 (1827) 252 *excl. syn.* Blume; *Azedarach excelsa* (Jack) Kuntze, Rev. Gen. 1 (1891) 110.

Tree to 50 m tall; bole to 120 cm diameter, regularly cylindrical or rarely slightly buttressed over major roots. **Bark** smooth, pinkish grey or pinkish brown, in large trees becoming longitudinally fissured and scaling, the flakes oblong, greyish, breaking off at upper end and curling up from both ends before shedding, the bole appearing pale brownish or greyish buff and shaggy. **Sapwood** white; heartwood light red. Crown rounded but rather open and uneven, deciduous for up to 3 months a year, the major branches ascending. **Twigs** 8–12 mm diameter apically, the pith pinkish but odourless or weakly onion-scented. Young shoots puberulous, soon glabrous. **Leaves** 20–60(–90) cm long, paripinnate or imparipinnate, tufted at ends of twigs; petioles 5–8 cm long, subterete, swollen at base; lateral leaflets 7–11 on each side of rachis; blades lanceolate-elliptical, 4–12.5 × 2–3.5 cm, the largest near the middle, asymmetrical, subfalcate, glabrous, pink when young, yellow when withering, base unequal, margin entire, apex subacute to subacuminate; lateral veins 6–11 on each side of midrib, arcuate; intercostal venation laxly reticulate; petiolules *c.* 2 mm long. **Inflorescences** 20–45 cm long, erect; axes puberulous, green with 3 or 4 orders of branching, main proximal branches to 8 cm long; bracts *c.* 1 mm long, narrowly triangular. **Flowers** sweetly scented; pedicels 1–3 mm long, articulated with pseudopedicel of same length; calyx *c.* 1 mm diameter, puberulous outside, lobes *c.* 1 mm long, rounded to subacute, pale green, margin ciliolate; petals oblong-spathulate, 5–6.5 × 1.5–2.2 mm, puberulous outside, pale creamy-white; staminal tube 2–2.5 mm diameter, glabrous outside, sparsely hairy distally inside, white or greenish, 10-ribbed, each rib terminating in a sub-bifid lobe, anthers (8–)10, *c.* 0.8 mm long, sessile, slightly exserted. **Fruits** ellipsoid, 2.4–3.2 × 1.3–1.6 cm, glabrous, green turning yellow at maturity; pericarp leathery; mesocarp soft, edible, with some white latex. **Seeds** smelling of garlic when damaged. **Seedlings** with serrate leaflets with long-acuminate tips.

Vernacular names. Sabah—*limpaga* (preferred name), *ranggu* (Dusun). Sarawak—*ranggu* (preferred name), *segera* (Malay; also applicable for a number of species of *Aglaia* and *Chisocheton*).

Distribution. Vietnam (?), Sumatra, Peninsular Malaysia (where also a village tree), Borneo (north and east), the Philippines, Sulawesi, Maluku (Aru) and Irian Jaya (W New Guinea). In Sabah, known from Beaufort, Keningau, Lahad Datu, Labuk Sugut, Ranau, Semporna, Tawau and Tenom districts (e.g., *Mabberley 1670*, *SAN 16843*, *SAN 43024*, *SAN 96653* and *SAN A 148*) and in Sarawak from Miri district (e.g., *S 1412*). Also occurs in Brunei (e.g., *BRUN 3123*) and Kalimantan (e.g., *bb. 23991*).

Ecology. Rain forest at altitudes to 350 m.

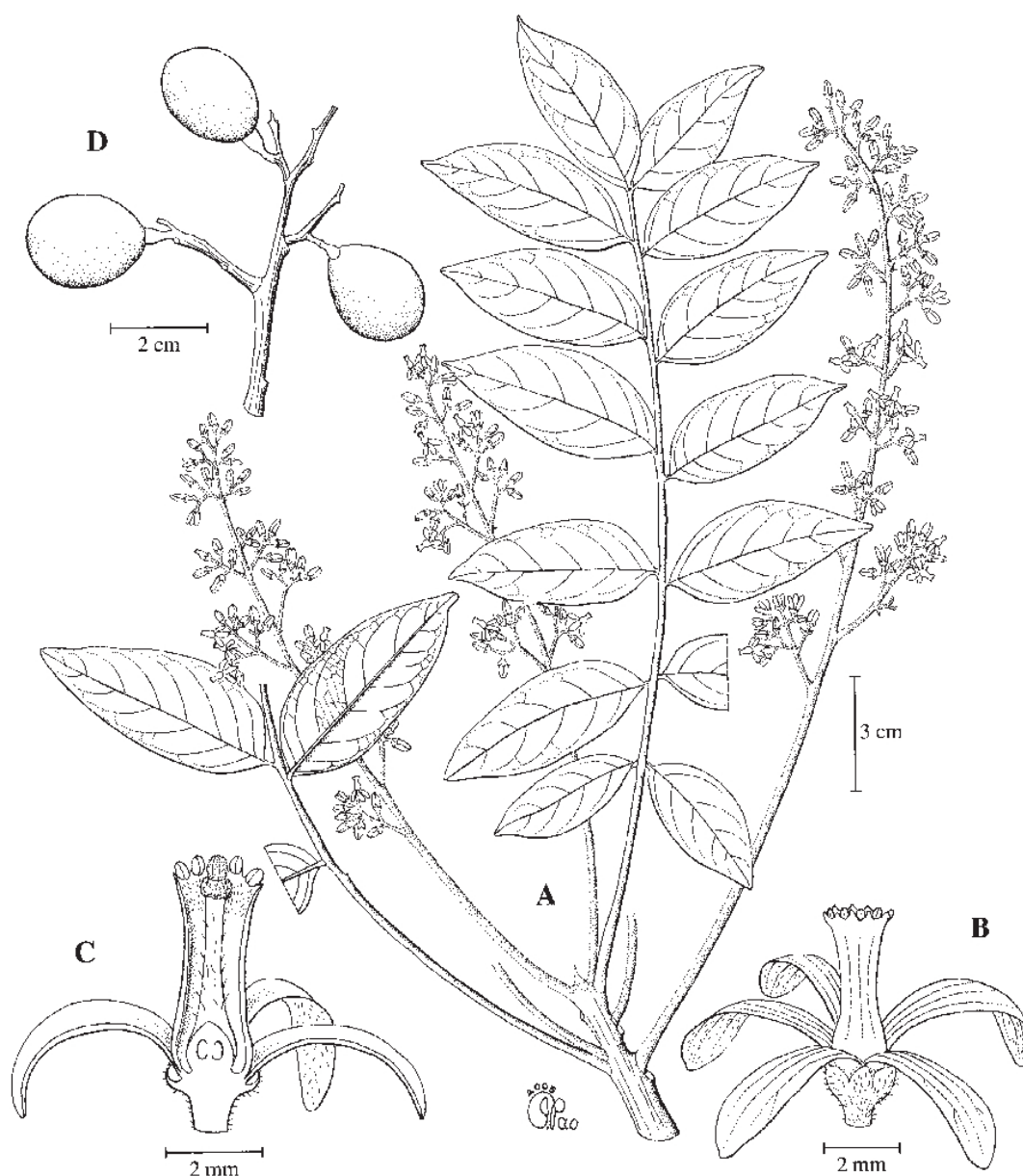


Fig. 12. *Azadirachta excelsa*. A, flowering leafy twig; B, flower; C, longitudinal section of flower; D, part of infructescence. (A from *FD FMS* 48757, B and C from *SAN A* 904, D from *SAN A* 790.)

Uses. The pink-red to brown timber is considered as one of the most attractive furniture timbers of Borneo. Grown in small-scale plantations, its timber is used in house building and also for handles and scabbards for knives, while the young shoots eaten as a vegetable. It coppices. The seeds yield azadirachtin (see *A. indica*) and the more effective insect antifeedant, marrangin.

Notes. At a distance the tree may be confused with *Ailanthus integrifolia* Lam. (Simaroubaceae) but the bark of that tree seems always to be smooth and leaflets wither red and not yellow (Corner *op. cit.* 1988).

4. CHISOCHETON Blume

(Greek, *schizos* = split, *chiton* = tunic; an allusion to the deeply lobed staminal tube of *C. patens*)

segera (preferred name in Sarawak)

Bijdr. Fl. Ned. Ind. 1 (1825) 168; Hiern *in* Hooker *f.*, Fl. Brit. Ind. 1 (1875) 550; King, J. As. Soc. Beng. 64, 1 (1895) 24; Merrill, EB (1921) 319, PEB (1929) 122; Ridley, FMP 1 (1922) 386; Masamune, EPB (1942) 374; Backer & Bakhuizen *f.*, FJ 2 (1965) 124; Pennington & Styles, Blumea 22 (1975) 497; Mabberley, Bull. Brit. Mus. Nat. Hist. Bot. 6 (1979) 301, *in* Mabberley & Pannell, TFM 4 (1989) 233, PB 2nd. ed. (1997) 152, Gard. Bull. Sing. 55 (2003) 189; Anderson, CLTS (1980) 250; Whitmore, Tantra & Sutisna CLK 2, 1 (1990) 227; Mabberley *et al.*, FM 1, 12 (1995) 136; Coode *et al.* (eds.), CLBD (1996) 203; Argent *et al.* (eds.), MNDT-CK 2 (1997) 416; PROSEA 5, 3 (1998) 159; Beaman & Anderson, PMK 5 (2004) 127. **Synonyms:** *Dasycoleum* Turcz., Bull. Soc. Nat. Mosc. 31 (1858) 414; *Megaphyllaea* Hemsl. *in* Hooker, Ic. Pl. 18 (1887) t. 1708; *Clemensia* Merr., Phil. J. Sci. (1908) 143.

Trees, pachycaul to leptocaul, sometimes unbranched, sometimes laticiferous, very rarely foetid, dioecious or polygamous. **Bud scales** *absent*. **Indumentum** *usually of simple*, rarely of 4-armed stellate hairs, sometimes irritant, with small glandular hairs. **Leaves** *pinnate and pseudogemmate* (gemmate = terminated in a crozier-like undeveloped leaflet bud) *or imparipinnate, very rarely paripinnate*. **Inflorescences** *thyrsoid or with long peduncles and congested racemes*, axillary to supra-axillary, borne on branches or rarely congested on bole. **Flowers** usually unisexual, rarely bisexual (e.g. *C. koordersii*), sometimes with elongated receptacle (pseudopedicel); calyx more or less cup-shaped, usually obscurely 3–6-lobed; *petals* (3 *or*) 4–6(–14) in 1 (or 2) whorls, free, aestivation imbricate, quincuncial or alternate, often merely at apices, or valvate, rarely weakly united below or with base of staminal tube; staminal tube cylindrical, margin entire, crenate or with 4–10(–30) emarginate, truncate or narrowly lanceolate 2(or 3)-fid lobes, anthers (3 *or*) 4–10(–30), usually attached within the tube, alternating with lobes, usually locellate (= divided into secondary, smaller compartments); disc usually absent, less often stipitate, annulate or discoid, occasionally lobed; ovary 2–8-locular, each locule with 1 or 2 collateral or superposed orthotropous ovules, stylehead clavate or discoid. **Fruits** 2–5(–8)-valved *capsules*, the valves 1(or 2)-seeded. **Seeds** obovoid-spheroid to scutelliform (= platter-shaped) or orange-segment-shaped, variously arillate or sarcotestal, orthotropous, with large chalaza; embryo with collateral, oblique or superposed cotyledons; radicle abaxial or included. Germination cryptocotylar; eophylls spirally arranged, simple, entire.

Distribution. About 53 species from India (Assam) and tropical China throughout Malesia south-eastwards to northern New South Wales and Vanuatu. In Sabah and Sarawak, the genus is represented by 21 species (including 2 incompletely known ones).

Ecology. Rain forest at altitudes to 1500 m, typically understorey trees, occasionally persisting in relict forest edges, rarely colonists of clearings.

Notes. Within the genus, there are species with imparipinnate leaves, paripinnate leaves (some forms of *Chisocheton patens*), but the majority have the leaf terminated by a pseudogemmula, which is a crozier-like bud of undeveloped leaflets, from which leaflets unfold at intervals. Some species are intermediate between the truly pseudogemmulate and the imparipinnate in that all the leaflets that will develop are produced in one flush, though the most apical may be tardy in expanding. Such is a common state of affairs in some species of *Dysoxylum*.

Uses. The wood of several *Chisocheton* species is locally used for various types of light construction, e.g., boat-building, interior finishing, furniture and cabinet work, flooring, mouldings, wall-panelling, for making sport-goods, boxes, crates and toys. It has also been utilised for manufacturing rotary veneer, plywood, block-board and particle-board and has been reported as suitable for the production of pulp. The seeds of some species yield an oil which has been used as an illuminant (PROSEA 5, 3 (1998) 159–162).

Key to *Chisocheton* species

1. Inflorescences borne on long-lived bosses on bole.....2
 Inflorescences otherwise.....3
2. Twigs 12–15 mm diameter apically. Petioles 8–20 cm long. Leaflets oblong, base strongly asymmetrical; petiolules *c.* 6 mm long. Inflorescences to 12 cm long. Calyx cup-shaped, margin 4- or 5-lobed. Petals 5 or 6, red towards apex (when fresh). Anthers non-locellate. Fruits to 5 cm diameter.....**15. C. ruber**
 Twigs 5–7 mm diameter apically. Petioles 5–10 cm long. Leaflets ovate or elliptical, base slightly asymmetrical; petiolules (4–)6–12 mm long. Inflorescences to 50 cm long. Calyx campanulate (bell-shaped), margin more or less entire. Petals (3 or) 4 (or 5), pale yellow to white (when fresh). Anthers locellate. Fruits to 7 cm diameter.....**4. C. cumingianus** (subsp. **kinabaluensis**)
3. Calyx (10–)13–20(–23) mm tall.....4
 Calyx shorter.....5
4. Twigs to 5 cm diameter apically. Petioles glabrescent or sparsely hairy. Leaflets more or less puberulous below, base obtuse to subacute. Inflorescences to 220 cm long. Petals 6–10. Anthers 16–30. Stylehead capitate. Fruits bright vermilion-tomentose (when fresh), with deciduous irritant hairs. Seeds arillate.....**9. C. macranthus**
 Twigs to 2.5 cm diameter apically. Petioles more or less fulvous-tomentose. Leaflets densely fulvous-tomentose below, base narrowed into the petiole. Inflorescences to 30 cm long. Petals 9–14. Anthers 15–20. Stylehead discoid to shallowly cylindrical. Fruits golden-brown when fresh, densely hispid (beset with coarse rigid erect hairs). Seeds sarcotestal.....**11. C. medusae**

5. Leaves imparipinnate.....6
 Leaves pseudogemmulate.....8
6. Petals to 16 mm long.....**3. C. crustularii**
 Petals 20 mm or longer.....7
7. Leaves to 100 cm long; petioles to 35 cm long; leaflets more or less densely ferruginous-setose (beset with bristly hairs) on both surfaces, dry setae tinkling when stroked, base rounded to attenuate, symmetrical; lateral veins 17–20 on each side of midrib; petiolules 5–6(–10) mm long. Inflorescences more or less densely setose. Calyx *c.* 3 × 4 mm. Petals more than 32 mm long, glabrous. Margin of staminal tube with 6–8 truncate lobes or irregularly lobed, anthers 6–8, *c.* 2 mm long, scarcely locellate. Fruits densely setose (hairs non-irritant).....**18. C. setosus**
 Leaves to 150 cm long; petioles 1–5 cm long; leaflets glabrous or pubescent on veins above, appressed hirsute below, base cuneate or subcordate, asymmetrical; lateral veins *c.* 15 on each side of midrib; petiolules to 2 mm long. Inflorescences ferruginous-pubescent. Calyx 5–8 × 5–6 mm. Petals 28–32 mm long, densely pubescent outside. Margin of staminal tube with 12–14 linear lobes, anthers 12–14, *c.* 4 mm long, locellate. Fruits beset with reddish irritant hairs..**14. C. polyandrus (in part)**
8. Leaves with stellate hairs.....**7. C. koordersii**
 Leaves with only simple hairs.....9
9. Petals 28–32 mm long. Pachycaul treelet with irritant fruit hairs.....**14. C. polyandrus (in part)**
 Petals smaller. Fruits glabrous or if hairy, the hairs non-irritant.....10
10. One or more petals narrower than and enclosed by the others.....**16. C. sarasinorum**
 Petals more or less of the same width or, at least, none completely enclosed by the others.....11
11. Staminal tube not conspicuously lobed (if unclear follow alternative).....12
 Staminal tube crenate to conspicuously lobed.....13
12. Twigs non-lenticellate, without distinct petiole scars. Leaves to 200 cm long; pseudogemmula not markedly circinate (crozier-like); lateral leaflets to 26 on each side of rachis; blades elliptical to elliptical-oblong, apex abruptly caudate-acuminate with an acumen to 2 cm long; lateral veins 10–14 on each side of midrib, strongly prominent below when dry; petiolules *c.* 6 mm long. Inflorescences to 50 cm long. Anthers somewhat ciliate posteriorly. Ovary 2-locular, stylehead subcapitate. Fruits *c.* 4 cm diameter, densely ferruginous-pubescent. Seeds 2, partly arillate.....**17. C. sarawakanus**
 Twigs lenticellate, with distinct petiole scars. Leaves to 120 cm long; pseudogemmula markedly circinate; lateral leaflets to 12 on each side of rachis; blades oblong to oblong-ovate, apex abruptly short-acuminate, lateral veins *c.* 22 on each side of midrib, subprominent below; petiolules 8–12 mm long. Inflorescences to 25 cm long. Anthers glabrous. Ovary 5-locular, stylehead shortly cylindrical. Fruits to 9 cm diameter, glabrous. Seeds 4 or 5, non-arillate.....**6. C. granatum**
13. Corolla aestivation imbricate.....14
 Corolla aestivation valvate.....19

14. Ovary 4-locular. Seeds (3 or) 4.....15
 Ovary 2-locular. Seeds 2.....16

15. Twigs 3–7 mm apically. Leaves 20–95 cm long; leaflets elliptical to elliptical-oblong, apex long-caudate; petiolules 2–5 mm long. Calyx 3–4 mm tall, subglabrous to sparsely pubescent. Petals narrowly obovate, 15–25 × 2–3 mm. Anthers scarcely locellate, included. Disc prominent, subtubular, 0.5–1 mm tall. Fruits *c.* 4 cm diameter.....**1. C. amabilis**
 Twigs 12–15 mm diameter apically. Leaves to 130 cm long; leaflets oblong-ovate, apex acute to short-acuminate; petiolules to 9 mm long. Calyx *c.* 2 mm tall, sericeous. Petals linear-spathulate, *c.* 11 × 1.8 mm. Anthers locellate, slightly exserted. Disc obscure. Fruits at least 9 cm diameter.....**10. C. maxilla-pisticis**

16. Disc present.....17
 Disc absent.....18

17. Lateral leaflets to 5 on each side of rachis; blades to 42 × 10.5 cm, apex acuminate, acuminate to 18 mm long; intercostal venation prominent on both surfaces; petiolules 6–11 mm long. Calyx *c.* 1.5 mm tall, margin obscurely 4-lobed. Anthers weakly locellate. Disc annular, thick. Fruits to 7 cm diameter. Seeds *c.* 3 cm diameter....**8. C. lansiifolius**
 Lateral leaflets to 14 on each side of rachis; blades 6–28 × 2.5–10.5 cm, apex short-acuminate, intercostal venation often conspicuous but not prominent; petiolules 3–6 mm long. Calyx 2.5–3 mm tall, margin subentire to minutely, irregularly toothed. Anthers locellate. Disc absent or very short. Fruits to 4.5 cm diameter. Seeds *c.* 0.8 cm diameter.....**12. C. patens** (in part)

18. Leaves to 200 cm long; lateral leaflets to 26 on each side of rachis. Margin of staminal tube crenate, anthers somewhat ciliate posteriorly; style head subcapitate.....**17. C. sarawakanus**
 Leaves to 70 cm long; lateral leaflets to 14 on each side of rachis. Margin of staminal tube with (5 or) 6–8 linear-triangular lobes, anthers glabrous. Style head cylindrical to clavate.....**12. C. patens** (in part)

19. Twigs deciduously tawny-pubescent to subglabrous.....20
 Twigs fawn-pubescent.....21

20. Twigs 4–12 mm diameter apically. Leaves to 150 cm long; petioles 10–15 cm long; lateral leaflets to 17 on each side of rachis. Inflorescences paniculate. Petals 13–19 mm long. Lobes of staminal tube subtruncate. Fruits *c.* 4.5 cm diameter....**2. C. ceramicus**
 Twigs 2.5–6 mm diameter apically. Leaves to 45 cm long; petioles 2–10 cm long; lateral leaflets to 9 on each side of rachis. Inflorescences spicate to thyrsoid. Petals 8–12(–18) mm long. Lobes of staminal tube lacinate (cut into narrow lobes). Fruits to 2.1 cm diameter.....**13. C. pentandrus**

21. Twigs 4–5 mm diameter apically. Leaves to 36 cm long; petioles 5–8 cm long; lateral leaflets to 6 on each side of rachis; blades *c.* 10 × 8 cm, softly and shortly rusty-pubescent below; lateral veins 6–8 on each side of midrib. Inflorescences to 14(–25) cm long. Calyx *c.* 4 mm tall, margin truncate to praemorse (appearing gnawed). Petals narrowly boat-shaped, 9–13 mm long.....**5. C. erythrocarpus**

Twigs 12–25 mm diameter apically. Leaves to 100 cm long; petioles 10–15 cm long; lateral leaflets at least 12 on each side of rachis; blades to 24 × 9 cm, densely velutinous below; lateral veins 15–17 on each side of midrib. Inflorescences to 40 cm long. Calyx c. 6 mm tall, margin obscurely 4-lobed or truncate. Petals linear-spathulate, to 16 mm long.....**19. C. velutinus**

1. *Chisocheton amabilis* (Miq.) C.DC.

(Latin, *amabilis* = lovely)

In A.P. de Candolle, Mon. Phan. 1 (1878) 537; Merrill *op. cit.* (1921) 319; Masamune *op. cit.* 374; Mabberley *op. cit.* (1979) 344, *op. cit.* (1989) 234; Whitmore, Tantra & Sutisna *op. cit.* 227; Mabberley *et al. op. cit.* 163; Turner, Gard. Bull. Sing. 47 (1995) 339; Coode *et al.* (eds.) *op. cit.* 203. **Basionym:** *Schizochiton amabile* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 26, 27. **Type:** Korthals s.n., Borneo, Kalimantan, Barito River, 1836 (holotype U; isotype L). **Synonyms:** *Schizochiton amabile* Miq. var. *sumatranum* Miq. *op. cit.* (1868) 28; *Chisocheton illustris* Ridl., Bull. Misc. Inform. Kew (1930) 366; *Chisocheton hackenbergii* Harms, Notizbl. Bot.Gart. Berlin 15 (1941) 476; *Chisocheton brachyanthus* auct. non Merr. (1922); Anderson, Gard. Bull. Sing. 20 (1963) 165, *op. cit.* (1980) 251.

Tree, 6–17 m tall; bole to 10 cm diameter. **Bark** smooth to finely cracked or pustulate, grey-green; inner bark cream. **Sapwood** white. **Twigs** 3–7 mm diameter apically, non-lenticellate, drying reddish. **Leaves** 20–95 cm long, pseudogemmulate, pseudogemma fulvous-tomentose; petioles 5–15 cm long; rachis terete or drying laterally channelled; leaflets coriaceous, shiny above, duller below, glabrous on both sides, or midrib brown-tomentose above and/or venation pubescent below (hairs simple); lateral leaflets (4–)7–20 on each side of rachis, opposite; blades of most proximal leaflets regularly elliptical, 2.2–11.5 × 1.9–4.8 cm, that of most distal leaflets elliptical-oblong, somewhat asymmetrical, 7.5–25.5 × 2.4–8.5 cm, base subequally acute to obtuse, apex long-cuspidate; lateral veins 5–14 on each side of midrib, ascending, subprominent to prominent below; petiolules 2–5 mm long. **Inflorescences** thyrsoid, 8–45 cm long, pendent, fragrant, borne in axils of youngest leaves, thus sometimes appearing terminal, often supra-axillary; axes glabrous to weakly pubescent, 3–5 mm diameter; males 1- or 2-branched with pubescent pedicels articulated on slender branchlets 3–4 mm long arising from first-order branches to 9 cm long; females unbranched, spicate and minutely pedunculate with subsessile flowers condensed into short dense cymes, mostly at distal end of rachis. **Flowers:** calyx cup-shaped, 3–4 mm tall, 4- or 5-lobed, subglabrous to weakly pubescent, green; petals 5 or 6, narrowly obovate, 15–25 × 2–3 mm, white or sometimes also pink at the tips, outside sparsely hairy or glabrous, drying reddish, aestivation imbricate (alternate to quincuncial); staminal tube subglabrous to villous outside, especially at base of lobes, villous inside especially near base, margin 5–7-lobed, the lobes subentire to irregularly 2- or 3-fid, anthers 8–10, c. 1.5 mm long, scarcely locellate, long-pubescent outside, included within lobes; disc prominent, 0.5–1 mm tall, subtubular, thick; ovary 4-locular, style pubescent, particularly in proximal half, stylehead subcylindrical to spherical. **Infructescences** borne on leafy twigs to 8 mm diameter. **Fruits** spherical, c. 4 cm diameter, long-stipitate, glabrous, pink ripening to bright rose-red, clustered in groups of 3–10 at end of rachis; stipe 1.7–2.2 cm long; valves 3 or 4. **Seeds** (3 or) 4, c. 9 mm long with chestnut-brown testa half covered in circumhilar yellow-orange aril.

Vernacular name. Sarawak—*buah pesak kanan* (preferred name).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known in Sarawak from Daro, Miri, Mukah, Sarikei and Sibu districts (e.g., *S* 4161, *S* 8087, *S* 9269, *S* 12947 and *S* 25565), in Brunei (e.g., *BRUN* 15641, *KEP* 32552 and *SAN* 17454) and in Kalimantan (e.g., *Kostermans* 8026). Not yet recorded from Sabah.

Ecology. Peatswamp forest and riparian forest at 0–20 m altitude. According to Corner (Gard. Bull. Sing. Suppl. 1 (1978) 30) it flowers gregariously in April–May at Sg. Sedili, Johore, Peninsular Malaysia, where it is restricted to the *mempisang* (*Polyalthia sclerophylla* Hook.f. & Thoms.) belt.

Notes. Specimens with inflorescences borne on reduced axillary branches are known from Sarawak and Kalimantan.

2. *Chisocheton ceramicus* (Miq.) C.DC.

(from Ceram (Seram), Maluku)

In A.P. de Candolle, Mon. Phan. 1 (1878) 533; Mabblerley *op. cit.* (1979) 361, *op. cit.* (1989) 234; Whitmore, Tantra & Sutisna *op. cit.* 228; Mabblerley *et al. op. cit.* 179; Turner *op. cit.* 339; Coode *et al.* (eds.) *op. cit.* 203; Argent *et al.* (eds.) *op. cit.* 416; PROSEA 5, 3 (1998) 161; Beaman & Anderson *op. cit.* 127. **Basionym:** *Schizochiton ceramicum* Miq. *op. cit.* (1868) 27, 29. **Type:** Teijsmann [& de Vriese] s.n. [HB 5027], Maluku, Seram (holotype U [Acc. No. 0004298]). **Synonyms:** *Schizochiton spectabile* Miq. *op. cit.* (1868) 27, 29; *Chisocheton spectabilis* (Miq.) C.DC. *op. cit.* (1878) 539, Merrill *op. cit.* (1921) 320; *Chisocheton clementis* Merr., Philip. J. Sc. 3 (1908) 145; *Chisocheton rhytidocalyx* Airy Shaw, Bull. Misc. Inform. Kew (1940) 256. (For full synonymy cf. Mabblerley *op. cit.* 1979.)

Tree to 30 m tall; bole to 40 cm diameter; buttresses to 3 m tall, 2 m out. **Bark** dippled, lenticellate, dark brown, tardily white-laticiferous; inner bark dark red-brown. **Sapwood** yellow. **Twigs** *subglabrous*, with conspicuous petiole scars, 4–12 mm diameter apically. **Leaves** to 150 cm long, *pseudogemmate*; petioles 10–15 cm long; rachis 2.5–6(–11) mm diameter, terete to angled; leaflets reddish when expanding, inconspicuously appressed hairy (*hairs simple*) notably on veins below; lateral leaflets to 17 on each side of rachis, opposite; blades ovate to oblong, (4–)10–38 × (2.7–)5.5–14.5 cm, base acute to rounded, apex acuminate; midrib sunken above; lateral veins 10–15 on each side of midrib; petiolules (3–)6–13 mm long. **Inflorescences** *paniculate*, axillary or supra-axillary, to 65 cm long, branched to 2nd or 3rd orders; branches to 45 cm long, more or less ascendant. **Flowers** fragrant; pedicels short, pseudopedicels 2.5–3.5 mm long; calyx shallowly cup-shaped to cylindrical, 2–5.5 mm tall, sometimes thickened annularly, margin truncate to obscurely 5-lobed; petals (4 or) 5 (or 6), 13–19 × 2–3 mm, pinkish, aestivation valvate; staminal tube sericeous except at both ends, occasionally subglabrous outside, margin (4 or)5(–8)-lobed, the lobes to 4 mm long, more or less truncate, anthers (4 or) 5 or 6 (–9), 2.8–3.8 mm long, locellate; ovary 2- or 3-locular, style densely pubescent except at apex, stylehead shortly cylindrical. **Infructescences** to 45 cm long, pendent. **Fruits** *subglobose*, to 3.2 × 4.5 cm, velutinous (*hairs non-irritant*), fleshy, orange-red; stipe to 1.5 cm long; pericarp thick, spongy, with 2 strong and 2 faint sutures; latex white to colourless. **Seeds** 1 or 2, shining pale orange; sarcotesta with 1.5 mm hole near micropyle.

Vernacular names. Sabah—*bekak* (Malay), *kalantopak* or *lantupak* (Dusun). Sarawak—*bekak* (Malay), *segera* (Iban).

Distribution. Vietnam, Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Maluku, New Guinea and New Britain. In Borneo, known in Sabah from Beaufort, Kinabatangan, Kota Belud, Kota Marudu, Labuk Sugut, Lahad Datu, Ranau, Sandakan and Tawau districts (e.g., *SAN* 30677, *SAN* 32026, *SAN* 62166, *SAN* 94712 and *SAN* 106067) and in Sarawak from Bintulu, Kapit, Kuching, Limbang, Lubok Antu, Marudi, Miri and Sri Aman districts (e.g., *Mabberley* 1624, *S* 28269, *S* 38388, *S* 40144, *S* 60007 and *S* 68179). Also occurring in Brunei (e.g., *BRUN* 5221) and Kalimantan (e.g., *Kostermans* 10588 A).

Ecology. In forests and as a relic in forest edges, at 0–700(–1100) altitude.

3. *Chisocheton crustularii* Mabb.

(Latin, *crustularius* = a pastrymaker; an allusion to the tart-shaped disc)

Bull. Brit. Mus. Nat. Hist. Bot. 6 (1979) 327; Whitmore, Tantra & Sutisna *op. cit.* 228; Mabberley *et al. op. cit.* 146. **Type:** *Ilias* *S* 22921, Borneo, Sarawak, Marudi district, Tinjar, Ulu Sg. Dapoi (holotype K; isotypes FHO, SAR).

Tree to 8 m tall; bole to 8 cm diameter, sometimes with small rounded buttresses. **Bark** greyish, narrowly fissured. **Twigs** *c.* 1.5 cm diameter apically. **Leaves** to 135 cm long, *imparipinnate*; rachis terete, subglabrous; leaflets glabrous above, sparsely strigose, especially on the venation below; lateral leaflets up to 10 on each side of rachis, opposite; blades to 38 × 10 cm distally, to 1.8 × 1 cm and pseudostipulate proximally, that of the terminal ones narrowly elliptical or oblong, *c.* 45 × 13.5 cm, base shortly attenuate to subtruncate, apex acuminate; lateral veins *c.* 24 on each side of midrib, prominent below; intercostal venation conspicuous, subscalariform; petiolules 0–16 mm long, swollen. **Inflorescences** (only males known) 38(–150) cm long, *axillary*, pendent, slender; axes 2–3 mm diameter, sericeous, the flowers in fascicles in the distal half. **Flowers:** pedicels 2–4.5 mm long, recurved, hispid; *calyx* cup-shaped, *c.* 3 × 5.5 mm, pubescent outside, margin entire to weakly crenate; *petals* 5, *narrowly oblong*, *c.* 16 × 4.5 mm, white, appressed pilose outside, glabrous inside; staminal tube *c.* 14.5 mm tall, subglabrous save for broad band of appressed hairs apically outside, margin with 11 irregularly bifid lobes *c.* 3.5 mm long, anthers 11, *c.* 2 mm long, included, hardly locellate; disc *c.* 0.5 mm tall, margin with recurved lobes; style filiform with a tuft of long hairs at its base, stylehead spherical, *c.* 1 mm diameter. **Fruits** unknown.

Distribution. Endemic in Borneo and known from only two collections from Tinjar, Marudi district, in northern Sarawak (*S* 22921 and *S* 23329).

Ecology. Presumably rain forest.

Notes. Very close to *Chisocheton setosus* but differs in its subglabrous twigs, leaf rachis and leaflets (vs. densely ferrugineous-setose); narrowly oblong less than 16 mm long petals (vs. subspathulate petals more than 20 mm long) and shorter staminal tube to 14.5 mm long (vs. to 32 mm long) with 11 irregularly bifid lobes (vs. with 6–8 truncate lobes).

4. *Chisocheton cumingianus* (C.DC.) Harms

(Hugh Cuming (1791–1865), English traveller, naturalist and plant collector)

In Engler & Prantl, Pflanzenfam. 3, 4 (1896) 296; Mabberley, Taxon 26 (1977) 528, *op. cit.* (1979) 347; Whitmore, Tantra & Sutisna *op. cit.* 228; Mabberley *et al. op. cit.* 164; PROSEA 5, 3 (1998) 161; Beaman & Anderson *op. cit.* 127. **Basionym:** *Dasycoleum cumingianum* C.DC. *op. cit.* (1878) 541. **Type:** *Cuming 842*, the Philippines, Luzon, Albay (holotype G; isotypes A, BM, K, L, LE). **Synonym:** *Chisocheton kinabaluensis* Merr., J. Str. Br. Roy. As. Soc. 86 (1922) 316, Masamune *op. cit.* 374.

Distribution. Continental Asia from India (Assam) and tropical China through Indo-China to the Philippines, Borneo, Sulawesi, Maluku, New Guinea and Bismarck Archipelago.

Ecology. Rain forest at altitudes to 1300 m.

Notes. Three subspecies are recognized: subsp. *cumingianus* (Philippines to New Ireland) with inflorescences borne on short shoots, supra-axillary or on twigs, rarely supra-axillary and simple; subsp. *kinabaluensis* with inflorescences borne on bole and subsp. *balansae* (C.DC.) Mabb. (Asian mainland) usually with rather pubescent leaves and axillary or supra-axillary thyrses. Of these, only subsp. *kinabaluensis* occurs in Borneo (Sabah only).

subsp. **kinabaluensis** (Merr.) Mabb.
(from Mt. Kinabalu)

Bull. Brit. Mus. Nat. Hist. Bot. 6 (1979) 349; Mabberley *et al. op. cit.* 166. **Basionym:** *Chisocheton kinabaluensis* Merr. *op. cit.* (1922) 316, Beaman & Anderson *op. cit.* 127. **Type:** *Clemens 10116*, Borneo, Sabah, Mt Kinabalu, Minitindok Gorge (holotype PNH†; isotype A).

Tree to 37 m tall; bole to 14 m tall, to 50 cm diameter; buttresses to 3 m tall, 2 m out or bole fluted to 10 m tall. **Bark** scaly, pale grey-brown; inner bark chestnut-brown. **Sapwood** straw. Larger branches with conspicuous petiole scars. **Twigs** 5–7 mm diameter apically, dark brownish black, smooth but conspicuously lenticellate, sometimes with white latex. Innovations more or less rusty-pubescent. **Leaves** to 120 cm long, *pseudogemmulate*, crowded in dense terminal spirals; *petioles* 5–10 cm long, 2.5–5 mm diameter, terete or weakly flattened adaxially; leaflets papery to coriaceous, drying red-brown, glabrescent or hispid-pubescent on the lateral veins above or, exceptionally, softly velutinous, *hairs simple*; lateral leaflets to 15 on each side of rachis, opposite or subopposite (proximally); *blades ovate to elliptical*, (6–)10–42 × (2–)5–14 cm, *base slightly asymmetrical*, acute, apex shortly cuspidate; lateral veins 10–15 on each side of midrib, ascending, arcuate, more or less prominent below; intercostal venation subprominent; *petiolules* (4–)6–12 mm long, glabrescent to tawny-tomentose. **Inflorescences** to 50 cm long, borne on short shoots (with 3–8 thyrses per shoot) on bole, 2- or 3-branched; branches to 10 cm long, more or less pubescent. **Flowers:** pedicels to 3(–4) mm long; bracteoles linear, *c.* 2 mm long; pseudopedicels to 1 mm long; *calyx campanulate* (= bell-shaped), 1–3 mm tall, puberulous outside, *margin more or less entire*; *petals* (3 or) 4 (or 5), spatulate, 12–20(–25) × 2.5 mm, acute, *pale yellow to white*, drying reddish; staminal tube *c.* 1 mm diameter, more or less glabrous outside, more or less pubescent inside from just below anthers to base, margin 6–9-lobed, lobes to 2.5 mm long, entire to 2- or 3-fid, *anthers* 6–9, elliptical-oblong, 1.5–2.2 mm long, *locellate*, glabrous to villous; disc annular, to 0.5 mm tall, glabrous; ovary in female (? and bisexual) flowers 3- or 4-locular, each locule with 1 (or 2) ovule(s), style pubescent in proximal 3/4, stylehead disciform to capitate. **Infructescences** to 30 cm long, pendent. **Fruits** globose to pyriform (= pear-shaped), to 7 cm diameter, occasionally weakly rostrate, orange-red, *glabrous to velutinous (hairs non-irritant)*; stipe to 1.5 cm long; pericarp usually with white latex. **Seeds** 3 or 4; testa blackish brown; aril circumhilar, margin crenate, sometimes with extension to micropyle, orange-red.

Distribution. Endemic in Sabah and known from Keningau, Labuk Sugut and Ranau districts (e.g., *Pennington* 7946, *RSNB* 2693A, *RSNB* 2827, *SAN* 74460 and *SAN* 94514).

Notes. The inflorescences are always borne on the bole, often very close to the ground indeed. It is noteworthy that, contrary to general expectation, it is the high altitude taxon which is the truly cauliflorous one in this species.

5. *Chisocheton erythrocarpus* Hiern

Plates 5B & C.

(Greek, *erythros* = red, *karpus* = fruit; red-fruited)

In Hooker *f.*, *Fl. Br. Ind.* 1 (1875) 550; King *op. cit.* 31; Ridley *op. cit.* (1922) 388; Mabberley *op. cit.* (1979) 368, *op. cit.* (1989) 235; Whitmore, Tantra & Sutisna *op. cit.* 228; Mabberley *et al. op. cit.* 183; Turner *op. cit.* 339; Coode *et al. (eds.) op. cit.* 203; PROSEA 5, 3 (1998) 161. **Type:** Maingay '322', Peninsular Malaysia, Malacca (holotype K). **Synonym:** *Chisocheton* sp. C, Mabberley *op. cit.* (1979) 372.

Tree to 25(–40) m tall; bole to 25(–40) cm diameter; buttresses to 1 m tall and out, 10 cm thick. **Bark** smooth to cracking, dark grey to chocolate-brown; inner bark reddish brown. **Sapwood** cream. Crown small. **Twigs** rough, dark brown, 4–5 mm diameter apically, densely and minutely rusty-tomentose. **Leaves** to 36 cm long, pseudogemmulate; petioles 5–8 cm long; leaflets chartaceous, glabrous above save for the puberulous midrib, softly and shortly rusty-pubescent (hairs simple) below; lateral leaflets to 6 on each side of rachis, opposite; blades elliptical-oblong to broadly ovate, c. 10 × 8 cm, base somewhat asymmetrical, cuneate or rounded, apex shortly, abruptly and bluntly acuminate; lateral veins 6–8 on each side of midrib, somewhat arcuate; petiolules to 1 cm long. **Inflorescences** to 14(–25) cm long, supra-axillary in upper axils, minutely rusty-tomentose; lateral branches short, squarrose, cymose. **Flowers:** pedicels short; calyx cylindrical, c. 4 mm tall, densely tomentose outside, glabrous inside, margin truncate to praemorse (= appearing gnawed); petals 5 or 6, narrowly boat-shaped, 9–13 × 3–3.5 mm, creamy-white, aestivation valvate, separating when dry, fleshy, appressed sericeous outside, glabrous inside; staminal tube, sericeous outside except at base and on lobes, pubescent similarly inside, 5- or 6-lobed, lobes toothed, c. 2.5 mm long, anthers c. 3 mm long, locellate, subsessile, basifixed at notches between lobes; ovary minutely pubescent save for a narrow band below stylehead, stylehead cylindrical, apically mamillate, glabrous. **Fruits** globose, peach-like, to 6 cm diameter, minutely beaked, minutely tomentose (hairs non-irritant), yellow when immature, blood-red when ripe; pericarp with white latex. **Seeds** 2, c. 2.5 cm long, somewhat flattened; sarcotesta thick, orange-red.

Vernacular name. Sabah—*lantupak* (Dusun). Sarawak—*segera* (Iban).

Distribution. Peninsular Malaysia, Borneo and the Philippines. In Borneo, recorded in Sabah from Beaufort, Kinabatangan, Kota Kinabalu, Kudat, Lahad Datu, Labuk Sugut, Papar, Ranau, Sandakan and Tenom districts (e.g., *SAN* 41320, *SAN* 60109, *SAN* 67234, *SAN* 126959 and *SAN* 139247) and in Sarawak from Lundu and Miri districts (e.g., *S* 47122 and *S* 76724). Also occurring in Brunei (e.g., *BRUN* 5033 and *Dransfield JD* 7259) and Kalimantan (e.g., *Burley et al.* 829).

Ecology. Predominantly in forest near the coast.

6. *Chisocheton granatum* Mabb.

(Latin, pomegranate (*Punica granatum* L., Lythraceae [Punicaceae]); alluding to the fruit-shape similar to that of *Xylocarpus granatum*)

Bull. Brit. Mus. Nat. Hist. Bot. 6 (1979) 354; Whitmore, Tantra & Sutisna *op. cit.* 228; Mabberley *et al. op. cit.* 170; Beaman & Anderson *op. cit.* 127. **Type:** *Clemens* 27299, Borneo, Sabah, Mt. Kinabalu, Dallas (holotype K; isotypes A, B, BM, G, L).

Tree to 15 m tall; bole to 8 m tall, to 17 cm diameter. **Bark** smooth, pale; inner bark pale yellow. **Sapwood** pale yellow. **Twigs** with distinct petiole scars, lenticellate, c. 6 mm diameter apically. **Leaves** to 120 cm long, pseudogemmulate, pseudogemma markedly circinate, in lax terminal spirals, more or less pubescent (hairs simple); petioles 5–10 cm long; lateral leaflets to 12 on each side of rachis, opposite; blades oblong to oblong-ovate, to 24 × 7.5 cm, drying pale below, base cuneate, somewhat asymmetrical, apex abruptly short-acuminate; lateral veins c. 22 on each side of midrib, weakly arcuate, almost reaching margin, drying subprominent below; petiolules 8–12 mm long. **Inflorescences** to 25 cm long, supra-axillary, often borne in axils of unexpanded leaves; branches to 6 cm long or short-stalked cymules (females). **Flowers:** calyx campanulate, 2.5–3 mm tall, pubescent, margin truncate; petals 4, linear-spathulate, 12–16 × 3.5 mm, creamy-white, pubescent outside, aestivation imbricate, forming a clavate corolla in males; staminal tube pubescent in distal half outside, glabrous inside, inflated near anthers, margin obscurely crenate or truncate, anthers 6, oblong, to 1.5 mm long, locellate, glabrous; ovary 5-locular, style pilose in proximal 3/4, stylehead shortly cylindrical, glabrous, apically lobed. **Fruits** depressed globose, to 9 cm diameter; valves 5, glabrous, tough, red-brown outside, white inside, without latex. **Seeds** 4 or 5, c. 3 cm long, when 4 scutiform (= shield-shaped), when 5 like orange-segments, non-arillate.

Distribution. Endemic in Borneo, known only in Sabah from Keningau, Kinabatangan, Pensiangan, Ranau, Tawau and Tenom districts (e.g., *Pennington* 7941, *SAN* 88971, *SAN* 91868, *SAN* 109155, *SAN* 112998, *SAN* 118790 and *SAN* 136989) and in Kalimantan (e.g., *Leighton* 1057B).

Ecology. In hill forest at altitudes (?300–)900–1500 m.

7. *Chisocheton koordersii* Mabb.

(Sijfer Hendrik Koorders, 1863–1919, Dutch Forest Officer, prolific collector and botanical author, based in Java)

Bull. Brit. Mus. Nat. Hist. Bot. 6 (1979) 368; Whitmore, Tantra & Sutisna *op. cit.* 228; Mabberley *et al. op. cit.* 184; PROSEA 5, 3 (1998) 161. **Lectotype** (designated here): *Koorders* 17978β, Sulawesi, Minahasa, Manado (L; isoelectotype BO, n.v.). **Synonyms:** *Chisocheton kingii* auct. non Harms (1896); *Koorders*, Minah. (1898) 385, 636, Fl. N.O. Celebes, Supl. 2 (1922) t. 43.

Tree to 30 m tall; bole to 14 m tall, to 60 cm diameter; buttresses to 1.5 m tall. **Bark** rather rough, finely fissured, brown, c. 0.5 mm thick; inner bark c. 5 mm thick, yellow to whitish. **Sapwood** white. **Twigs** (6–)8–12 mm diameter apically; pith wide, sometimes housing ants. *Young twigs, petioles, rachises, pseudogemmulae and leaflets (especially the veins) minutely stellate pubescent (hairs 4-armed).* **Leaves** to at least 35 cm long,

pseudogemmulate; petioles to 18 cm long, terete; lateral leaflets at least 7 on each side of rachis, opposite; blades elliptical to suboblong, to $25(-35) \times 10$ cm, base rounded, symmetrical, apex acuminate; lateral veins to 17 on each side of midrib; petiolules 5–9 mm long. **Inflorescences** to 45 cm long, *axillary*, thyrsoïd, branched to third order; major proximal branches to 18 cm long. **Flowers** apparently bisexual and non-bracteate, sessile, with short pseudopedicels, scented; *calyx* tubular-urceolate, $3.5-4 \times 2.5-3$ mm, minutely stellate-pubescent outside, glabrous inside, margin obscurely lobed, almost praemorse; petals 5 or 6, narrowly spatulate, 11–12 mm long, white, densely and minutely stellate-pubescent outside, glabrous inside, aestivation valvate, connate in the most proximal 1/4 to 1/3; staminal tube long simple-villous outside in band below lobes, glabrous inside save for a band of small ascendant simple hairs just below anthers, margin 5- or 6-lobed, lobes *c.* 2.5 mm long, more or less bifid, glabrous, anthers 5 or 6, 2–2.5 mm long, minutely apiculate, non-locellate, glabrous, sessile, basifixed in angle or lobes; disc cup-shaped, *c.* 1.5 mm tall, adnate to ovary, glabrous; ovary *c.* 2.5 mm long, minutely pubescent, style minutely pubescent in proximal 1/3 to 1/2, stylehead capitate. **Fruits** spherical, to 5 cm diameter, shortly stipitate, reddish tomentellous, 2-valved. **Seeds** 2, *c.* 3.5 cm diameter, scutellar (= platter-shaped), sarcotestal.

Distribution. Borneo and Sulawesi. In Borneo, known only in Sabah from Keningau and Tambunan districts (e.g., *SAN 44563* and *SAN 113582*) and in Kalimantan (e.g., *Kostermans 5592*).

Ecology. In rain forest at 10–600 m altitude.

8. *Chisocheton lansiifolius* Mabb.

Fig. 13, Plate 5D.

(Latin, *Lansium* (= *langsar*), *folium* = leaf; an allusion to the leaves resembling those of *Lansium domesticum*)

Bull. Brit. Mus. Nat. Hist. Bot. 6 (1979) 352; Whitmore, Tantra & Sutisna *op. cit.* 228; Mabberley *et al. op. cit.* 169; Coode *et al.* (eds.) *op. cit.* 203; Beaman & Anderson *op. cit.* 128. **Type:** *Ashton S 12141*, Borneo, Sarawak, Kapit district, Balleh, Ulu Mujong, Nanga Temiai (holotype K; isotypes A, FHO, KEP, L, SAN, SAR, SING).

Tree to 30 m tall; bole to 15 m tall, 25 cm diameter, sometimes fluted; buttresses (if present) to 2 m tall, *c.* 5 cm wide, concave. **Bark** smooth, dark brown; inner bark yellow. **Sapwood** pale brown. **Twigs** *c.* 8 mm diameter apically, dark brown, lenticellate, with distinct petiole scars. **Leaves** to 54 cm long, *paripinnate*, *pseudogemmulate*; petioles 8–15 cm long; leaflets coriaceous, subglabrous (*hairs simple*); *lateral leaflets to 5 on each side of rachis*, opposite; *blades* oblong-elliptical or oblong-ovate, to 42×10.5 cm, base acute to obtuse, *apex acuminate*, *acumen to 18 mm long*; lateral veins *c.* 14 on each side of midrib, arcuate; *intercostal venation drying prominent on both surfaces*; *petiolules 6–11 mm long*, drying blackish. **Inflorescences** to 65 cm long, paniculate, *axillary or extra-axillary*; proximal branches to 18 cm long, squarrose, branched, with the branches passing interceptibly, like the major branches on the main axis, into cymose fascicles of 1–6 flowers. **Flowers:** *calyx* cup-shaped, *c.* 1.5 mm tall, rugose, *margin obscurely 4-lobed*; *petals 4, 8–9 × 1.5 mm*, weakly pubescent outside, glabrous inside, creamy-white to pinkish, *aestivation imbricate*; *staminal tube* glabrous outside, cottony pubescent inside, *margin 6-lobed*, the lobes entire, lanceolate, *c.* 2 mm long, *anthers 6, c.* 2.5 mm long, glabrous, *weakly locellate*; *disc annular, thick*; *ovary 2-locular*, style terete, pilose in proximal 3/4, stylehead subcylindrical. **Infructescences** to 85 cm long; axis *c.* 8 mm diameter; branches bearing 1

or 2 fruits. **Fruits** subspherical, to 7 cm diameter, stipitate, red; valves 4. **Seeds** 2, scutiform, c. 3 cm diameter.

Distribution. Endemic in Borneo. In Sabah, known from Keningau, Kinabatangan, Kota Belud, Labuk Sugut, Lahad Datu, Ranau, Sandakan and Tawau districts (e.g., *SAN* 26978, *SAN* 30737, *SAN* 34971, *SAN* 87939 and *SAN* 134172) and in Sarawak from Limbang and Marudi districts (e.g., *S* 34950, *S* 34984 and *S* 42378). Also occurring in Brunei (e.g., *Coode* 6805) and Kalimantan (e.g., *Balgooy* 5501, *Endert* 5127, *Kostermans* 5490 and *Kostermans* 13249).

Ecology. In rain forests including peatswamp forest at altitudes to 1050 m.

9. *Chisocheton macranthus* (Merr.) Airy Shaw

(Greek, *makro* = large, *anthos* = flower; large-flowered)

In Hooker, Ic. Pl. 34 (1937) t. 3333; Mabblerley *op. cit.* (1979) 320; Anderson *op. cit.* (1980) 251; Whitmore, Tantra & Sutisna *op. cit.* 228; Mabblerley *et al. op. cit.* 141; Coode *et al.* (eds.) *op. cit.* 203; Beaman & Anderson *op. cit.* 128. **Basionym:** *Clemensia macrantha* Merr., Phil. J. Sci. Bot. 3 (1908) 144, *op. cit.* (1921) 321, *op. cit.* (1923) 371, *op. cit.* (1929) 122, Masamune *op. cit.* 375. **Syntypes:** *Clemens* 725 and *Clemens s.n.*, the Philippines, Mindanao, Lake Lanao, Camp Keithley (syntypes PNH†; probable isosyntype [see Mabblerley *op. cit.* (1979) 320] G). **Synonym:** *Chisocheton medusae* auct. non Airy Shaw (1937): Heine, Mitt. Bot. Staat. Münch. 6 (1953) 233.

Tree to 13(–20) m tall; bole to 22(–30) cm diameter, buttressed; branching fastigiate, often with several limbs from near base. **Bark** smooth; inner bark pale yellow. **Twigs** to 5 cm diameter apically, blackish, with large scutellar petiole scars. **Leaves** to 220 cm long, pseudogemmate, crowded in dense terminal spirals; petioles 5–20 cm long, woody, dark coloured, glabrescent to sparsely hairy; leaflets weakly bullate, glabrous above, more or less puberulous below; lateral leaflets to 19 on each side of rachis, opposite, sometimes more or less alternate at base of rachis; blades oblong-lanceolate or ovate when smaller, 20–45(–55) × (5–)8–12(–15) cm, base obtuse to subacute, apex acute to acuminate; lateral veins 15–24 on each side of midrib; intercostal venation scalariform; petiolules to 8 mm long. **Inflorescences** to 220 cm long, axillary or extra-axillary, pendent; axes terete to weakly angled, weakly branched; branches crowded towards apex, pilose, with up to 12 flowers each; bracts c. 6 mm long, pubescent, caducous. **Flowers:** pedicels c. 10 mm long, articulated with pseudopedicels; calyx cup-shaped to cylindrical, 14–20 mm tall, pubescent, red-brown, margin truncate to irregularly 3- or 4-lobed; petals 6–10, 30–45 × 4–7(–12) mm, creamy-pink; staminal tube 25–40 × 6–7 mm, creamy-white, glabrous outside except on lobes, pilose inside at base, margin entire or with lobes 4–6 mm long, anthers 16–30, c. 5 mm long, rather recurved, connective somewhat pubescent; disc flattened to weakly annular, glabrous; ovary c. 5 mm diameter, 5- or 6-locular, pilose, style pilose in proximal half or glabrous, stylehead capitate, c. 2 mm diameter. **Infructescences** borne in axils of last flush of leaves; axis to 3 m long with terminal bunches of up to 60 fruits. **Fruits** to 12 cm diameter, recurved, rostrate when immature, when fresh, bright vermilion-tomentose with irritant deciduous hairs. **Seeds** 2.5–3.3 cm long, triangular in cross-section; aril reddish, covering inner edges of black testa.



Fig. 13. *Chisocheton lansiifolius*. A, flowering leafy twig; B, male flower; C, longitudinal section of male flower; D, fruit. (A–C from SAN 79773, D from SAN 34971.)

Distribution. Borneo and the Philippines. In Sabah, known from Beaufort, Keningau, Kinabatangan, Kota Marudu, Labuk Sugut, Lahad Datu, Ranau, Sandakan and Tawau districts (e.g., *Clemens 10431*, *Pereira et al. 204*, *SAN 28119*, *SAN 66051* and *SAN 79842*) and in Sarawak from Belaga, Bintulu, Kapit, Marudi, Miri and Tatau districts (e.g., *S 17706*, *S 39918*, *S 45331* and *S 65084*). Also occurring in Brunei (e.g., *Johns 7145*) and Kalimantan (e.g., *Endert 2591* and *Hallier 1938*).

Ecology. Lowland rain forest, including that on limestone, at altitudes to 400 m.

10. *Chisocheton maxilla-pisticis* Mabb.

Fig. 14.

(Latin, *maxilla* = jaw, *pistix* = shark; an allusion to the appearance of the young leaves)

Gard. Bull. Sing. 55 (2003) 189. **Type:** *Sawan SAN 136830*, Borneo, Sabah, Telupid district, Pinangah FR (holotype SAN; isotypes KEP, SAR).

Tree with sparsely branched crown to 45 m tall; fluted bole to 90 cm diameter, with steep buttresses to 1(–3) m tall. **Bark** smooth to scaly, markedly lenticellate; inner bark red-brown. **Sapwood** pale yellow-white. **Twigs** 1.2–1.5 cm diameter apically, brown, with longitudinal cracks, petiole scars conspicuous, latex white, fulvous-tomentellous. **Leaves** in dense terminal spirals, to 130 cm long, pseudogemmulate, pseudogemma of rather unfurled leaflets, densely long-hairy; petioles 8.5–16.5 cm long, more or less angled or grooved, like rachis, sericeous to pilose; leaflets weakly falcate, young ones brownish or reddish, densely pilose (hairs simple) on midrib and lateral veins, also scattered between veins below; lateral leaflets at least 17 on each side of rachis, opposite; blades oblong-ovate, to 21 × 8.5 cm, base asymmetrical, rounded or, particularly in juveniles, cuneate, apex acute to shortly acuminate; lateral veins c. 17 on each side of midrib, spreading, when dry rather prominent above; petiolules to 9 mm long, densely pilose. **Inflorescences** narrowly panicle-like thyrses, to 50 cm long, axillary or extra-axillary, tomentellous; peduncles c. 18 cm long, branches rather distant, to 10 cm long, squarrose; ultimate branchlets cymulose, many-flowered. **Flowers:** pedicels tomentellous; calyx cup-shaped, c. 2 mm tall, sericeous, margin truncate to weakly 4-lobed; petals 4 or 5, linear-spathulate, c. 11 × 1.8 mm, sericeous outside, glabrous inside, aestivation imbricate, apex concave (corolla clavate in males); staminal tube swollen at mouth, weakly adherent to petals at base, hairy along interlobe sutures near apex outside, hairy inside, margin with 6–8 linear, 2- or 3-toothed lobes to 2.5 mm long, anthers 5–8(or 9), oblong, c. 2 mm long, locellate, basifixed, slightly exerted; disc obscure; ovary 4-locular, sericeous, style sericeous in proximal 5/6, stylehead subcylindrical with flattened apex. **Infructescences** to 30 cm long, axillary or on twigs behind leaves. **Fruits** spherical, to at least 9 cm diameter, red-brown, latex white; pedicel to 9 mm across. **Seeds** unknown.

Distribution. Borneo and the Philippines (Palawan). In Borneo, known only in Sabah from Kinabatangan, Lahad Datu, Ranau, Sandakan and Tawau districts (e.g., *SAN 31087*, *SAN 39141*, *SAN A 3696* and *SAN A 4769*) and in Kalimantan (e.g., *bb. 16168*, *Kostermans 6834* and *Kostermans 8897*).

Ecology. Lowland rain forest.

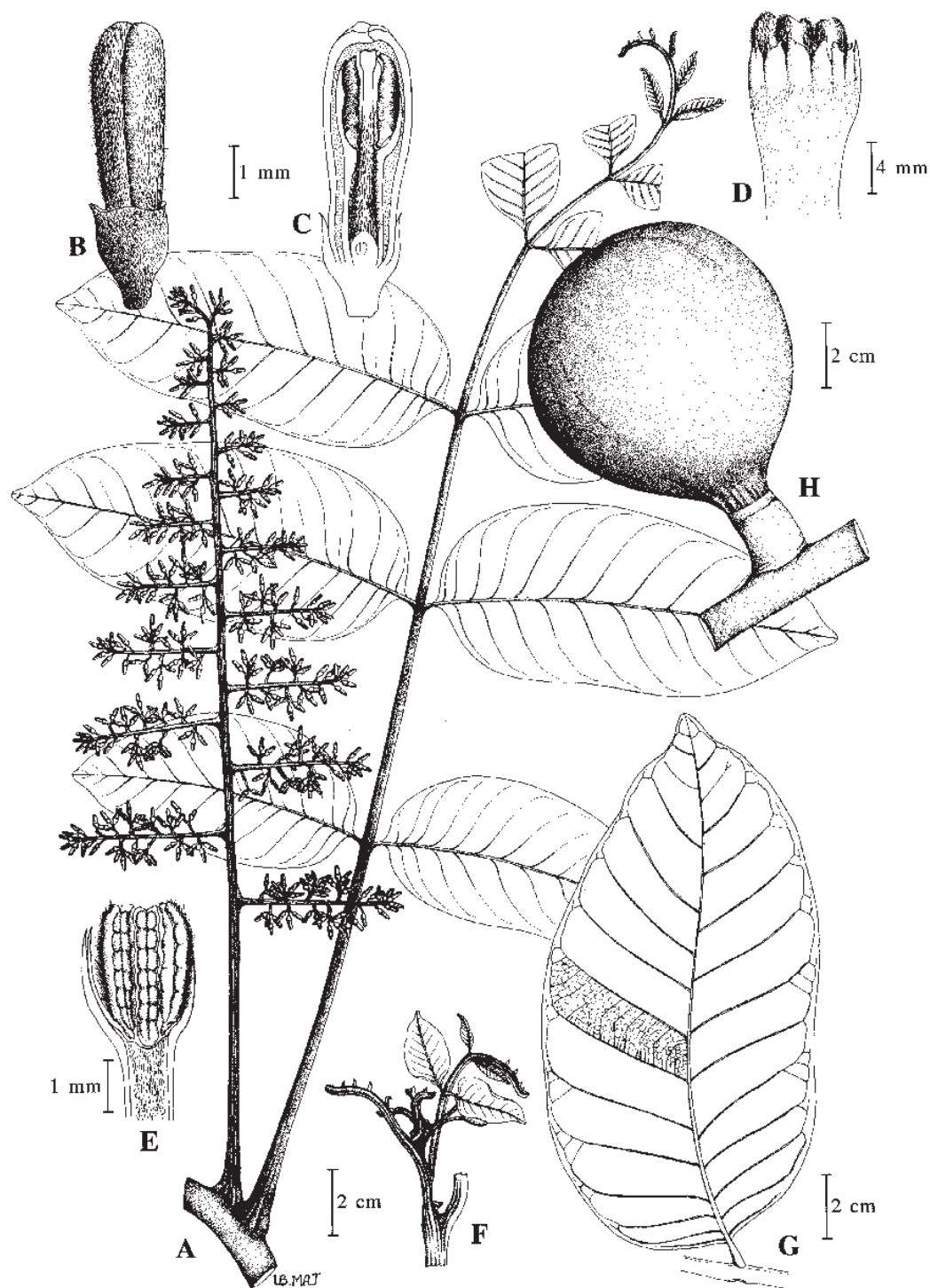


Fig. 14. *Chisocheton maxilla-pisticis*. A, flowering leafy twig; B, female flower bud; C, longitudinal section of female flower bud; D, abaxial view of distal part of staminal tube; E, adaxial view of distal part of staminal tube; F, young leafy shoot; G, older leaflet; H, fruit. (A–E from SAN 31087, F from SAN 136830, G from Pennington 7915, H from SAN A 4769.)

11. *Chisocheton medusae* Airy Shaw

Fig. 15.

(Medusa, the only human of the Gorgons, snake-haired sisters in Classical mythology; an allusion to the 'reflexed or subrevolute' petals)

In Hooker, Ic. Pl. 34 (1937) t. 3333; Mabberley *op. cit.* (1979) 322; Anderson *op. cit.* (1980) 251; Mabberley *et al. op. cit.* 142. **Type:** *Richards 2631*, Borneo, Sarawak, Marudi district, Mt Dulit (Ulu Tinjar), near Long Kapa (holotype K; isotype SING). **Synonyms:** *Megaphyllaea* sp. Merr. *op. cit.* (1929) 123; *Chisocheton medusae* Airy Shaw forma *hiascens* Jacobs, Reinwardtia 3 (1955) 265.

Tree to 28 m tall; bole to 30 cm diameter, sparsely branched, buttressed. **Bark** black with fine striations; inner bark dark brown. **Heartwood** yellowish. **Twigs** to 2.5 cm diameter apically, fulvous-tomentose. **Leaves** to 200 cm long, *pseudogemmate* (imparipinnate and with up to 4 lateral leaflets on each side of rachis when young), bunched in terminal spirals; *petioles* 10–20 cm long, terete or flattened adaxially, decurrent with twig and forming axillary cavity with it, *more or less fulvous-tomentose*; rachis somewhat angular, glabrescent to fulvous-tomentose; *leaflets* glabrous above when mature, *more or less densely fulvous-pubescent below*, green when young; lateral leaflets to 14 on each side of rachis, opposite except for those near base of rachis; blades lanceolate to elliptical-lanceolate, to 40 × 11 cm, *base narrowed into petiole*, apex acute to acuminate, acumen to 2 cm long; midrib stout, densely fulvous-tomentose below; lateral veins 20–24 on each side of midrib, weakly arcuate near margin, subpubescent above, prominent and pubescent below. **Inflorescences** to 30 cm long, borne in axils of upper or undeveloped leaves, weakly branched to narrowly paniculate at base; axes flattened to angular, shortly fulvous-tomentose when young, glabrescent; branches rather more densely pubescent, few-flowered with caducous bracts. **Flowers:** pedicels 3–20 mm long, somewhat angular, light-brown hirtellous, articulated with pseudopedicels, swollen at articulation; *calyx* cup-shaped to subcylindrical, (10–)13–20(–23) × 15–20 mm, more or less densely ferrugineous-velutinous, reddish brown, margin truncate or irregularly split to halfway into 2 or 3 more or less triangular lobes; *petals* 9–14, 35–40 × 2–6 mm, white; staminal tube 27–32 mm long, glabrous, thin proximally, margin truncate, *anthers* 15–20, slightly exserted or included, 3–4 mm long, glabrous; disc glabrous; ovary in female flowers 3–5 mm diameter, 7- or 8-locular, glabrous to densely yellow-hairy, style more or less pubescent, especially below, *stylehead discoid to shallowly cylindrical*, c. 2 mm diameter, glabrous. **Infructescences** to 30 cm long. **Fruits** to 13 × 10 cm diameter, *golden-brown, densely hispid*. **Seeds** to 5 cm long, orange-segment-shaped; *sarcotesta densely vascularised*.

Distribution. Endemic in Borneo. In Sabah, known from Kinabatangan, Labuk Sugut, Sandakan, Semporna and Tawau districts (e.g., *Mabberley 1680*, *SAN 37378*, *SAN 40604*, *SAN 63783* and *SAN 83437*) and in Sarawak from Bau, Belaga, Kapit, Marudi and Tatau districts (e.g., *ITTO/BB 498*, *S 19233*, *S 21788*, *S 39834* and *S 73871*). Also occurring in Kalimantan (e.g., *Kostermans 5897*) but not yet recorded from Brunei.

Ecology. Lowland rain forests, sometimes on limestone, at altitudes to 400 m.

Notes. This species has a short infructescence with sarcotestal seeds, whereas its apparently closest ally, *C. macranthus*, has a bell-rope-like infructescence and arillate seeds. *Chisocheton tomentosus* (Roxb.) Mabb. of Peninsular Malaysia (sarcotesta) and *C. polyandrus* of Borneo (aril) are a similar pair, but geographically vicarious.

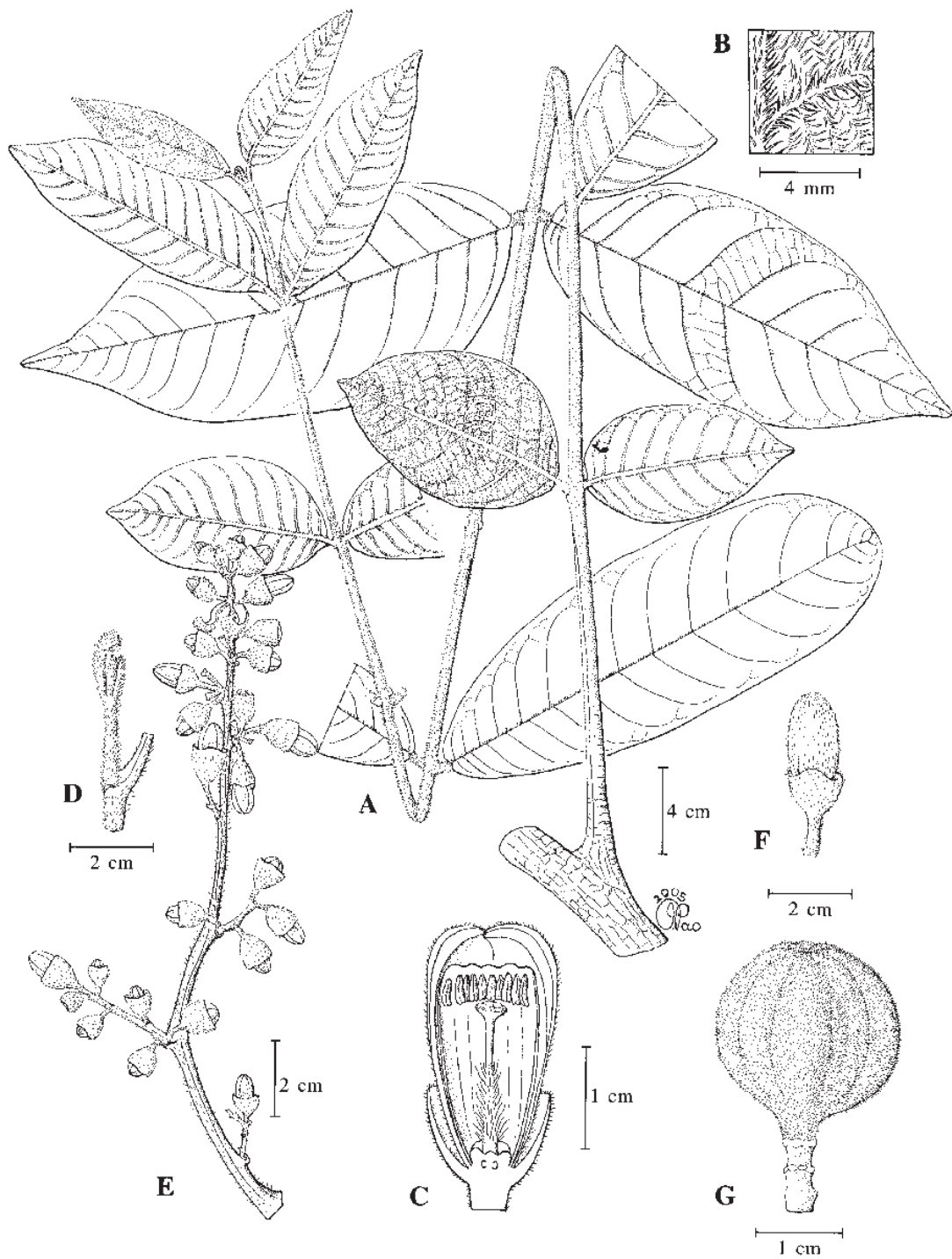


Fig. 15. *Chisocheton medusae*. A, leaf; B, details of lower leaflet surface showing indumentum; C, longitudinal section of flower bud; D, distal part of young shoot showing developing leaf bud; E, inflorescence with young flowers; F, flower bud; G, fruit. (A–C from S 23304, D from S 64629, E from S 21788, F from SAN 16501, G from SAN 83437.)

12. *Chisocheton patens* Blume

(Latin, *patens* = spreading; referring to the inflorescence)

Bijdr. Fl. Ned. Ind. (1825) 169; King *op. cit.* 522; Mabberley *op. cit.* (1979) 350, *op. cit.* (1989) 235; Whitmore, Tantra & Sutisna *op. cit.* 229; Mabberley *et al. op. cit.* 167; Turner *op. cit.* 340; Coode *et al. (eds.) op. cit.* 203; Argent *et al. (eds.) op. cit.* 416; PROSEA 5, 3 (1998) 162; Beaman & Anderson *op. cit.* 128. **Type:** *Blume s.n.*, Java (holotype L [Acc. No. 9081321993]; isotypes G, U [Acc. No. 0004305]). **Synonyms:** *Chisocheton divergens* Blume *op. cit.* (1825) 169, Ridley *op. cit.* (1922) 390, Backer & Bakhuizen *f. op. cit.* (1965) 124; *Chisocheton divergens* Blume var. *patens* (Blume) Ridl. *op. cit.* (1922) 390, *nom. illeg.*

Tree to 35 m tall, but often flowering when 2–3 m tall; bole to 20 m tall and 70 cm diameter, sometimes fluted or buttressed; buttresses to 2 m tall, to 1 m out and to 8 cm thick, concave. **Bark** pale greenish to black, smooth to faintly cracked, lenticellate, the lenticels in horizontal rows; inner bark pale to dark brown. **Sapwood** pale to dirty-cream, often smelling of methyl mercaptan. **Twigs** c. 6 mm diameter apically, glabrous to deciduously tomentose, bark dark, petiole scars conspicuous. **Leaves** to 70 cm long, *paripinnate*, *pseudogemmate*, in terminal bunches; petioles 7–15 cm long, glabrous to pubescent; leaflets thinly coriaceous, often conspicuously paler below, glabrous or with tomentose midrib and pubescent lateral veins on both surfaces, *hairs simple*; *lateral leaflets to 14 on each side of rachis*, opposite to subopposite, often maturing all together; blades narrowly oblong to oblong- or elliptical-lanceolate, 6–28 × 2.5–10.5 cm, base more or less rounded or rarely subcordate, more or less unequal, *apex shortly acuminate*; lateral veins 9–14 on each side of midrib, more or less prominent below; *intercostal venation often conspicuous*; *petiolules 3–6 mm long*. **Inflorescences** to 90 cm long, *borne in upper leaf axils or supra-axillary*, pendent, thyrsoid; most proximal branches to 17 cm long (10 cm long in females), ultimate branchlets cymes of subsessile or shortly pedicellate flowers; axes glabrous to tomentose. **Flowers** fragrant; bracteoles minute; *calyx cup-shaped to shortly tubular, 2.5–3 mm tall, puberulous, margin subentire to minutely, irregularly toothed*; *petals 4, subspathulate-elliptical, 5–10 mm long, aestivation imbricate*, glabrous to glabrescent; *staminal tube 5–7(–8) mm tall, glabrescent or minutely pubescent near mouth outside, pubescent, tomentellous or very rarely villous inside, margin with (5 or) 6–8 linear-triangular lobes a little shorter than anthers, anthers (5 or) 6 or 7 (or 8), basifixed, glabrous, locellate; disc absent or very short, fleshy*, glabrous, more or less lobed; *ovary 2-locular, pubescent, style glabrous to densely short-pubescent, stylehead cylindrical to clavate*. **Fruits** subglobose, to 5 × 4.5 cm, stipitate, *glabrous to tomentose* (especially when unripe; *hairs non-irritant*), *2-locular*; stipe to 2 cm long. **Seeds** 2, scutiform, 5–11 × 8 mm, half covered by an aril.

Vernacular name. Sabah—*berindu* (preferred name).

Distribution. Peninsular Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines and Sulawesi. In Sabah, known from Keningau, Kinabatangan, Kudat, Labuk Sugut, Lahad Datu, Pensiangan, Pitas, Ranau, Sandakan, Semporna, Tawau, and Tenom districts (e.g., *SAN 24761*, *SAN 34930*, *SAN 71008*, *SAN 94744* and *SAN 129746*) and in Sarawak from Kapit, Kuching and Lundu districts (e.g., *S 27053*, *S 33183*, *S 34201*, *S 39091* and *S 78277*). Also occurring in Brunei (e.g., *Kirkup DK 944a* and *Hotta 12947*) and Kalimantan (e.g., *Kostermans 8127*, *Kostermans 9963* and *Kostermans 10195*).

Ecology. Common in lowland rain forest, at altitudes to 500 m.

Notes. Some specimens (particularly in Peninsular Malaysia) have a stench like methyl mercaptan but this seems not to be constant in populations – its occurrence would make an interesting study. Across its range, *Chisocheton patens* is an extremely variable species, of which *C. lansiifolius* is a ‘satellite’, though it is rather uniform in Borneo. Some specimens from Sarawak, particularly from Semengoh FR near Kuching and Miri (e.g., *S* 27053, *S* 34201 and *S* 39091), however, are curious for their large coriaceous leaflets, which resemble those of *C. lansiifolius*. These are treelets to 3 m tall and require further study (*cf.* discussion under *Walsura pinnata* and *W. grandifolia*).

13. *Chisocheton pentandrus* (Blanco) Merr.

(Greek, *penta* = five, *andros* = man; referring to the five stamens in each flower)

Phil. Gov. Lab. Bur. Bull. 27 (1905) 210; Masamune *op. cit.* 375; Mabberley *op. cit.* (1979) 363, *op. cit.* (1989) 237; Mabberley *et al. op. cit.* 180; Turner *op. cit.* 340; Coode *et al.* (eds.) *op. cit.* 203; PROSEA 5, 3 (1998) 162; Beaman & Anderson *op. cit.* 128. **Basionym:** *Trichilia pentandra* Blanco, Fl. Filip. (1837) 355. **Neotype** (Mabberley, 1979): *Species Blancoanae* 6, the Philippines, Luzon, Mt Maquiling, Nov 1912 (fls) & Mar 1913 (fr) mounted on same sheet (BM). **Synonyms:** *Schizochiton paucijugus* Miq. *op. cit.* (1868) 27 & 30; *Chisocheton paucijugus* (Miq.) B.D. Jackson, Index Kew. 1 (1895) 517, Merrill *op. cit.* (1921) 319, Masamune *op. cit.* 374; *Dasycoleum beccarianum* Baill., Adansonia 11 (1874) 263; *Chisocheton beccarianus* (Baill.) Harms *op. cit.* (1896) 296, Merrill *op. cit.* (1921) 319, Masamune *op. cit.* 374, Anderson *op. cit.* (1980) 250.

Tree or treelet, 3–18(–40) m tall; bole to 10 m tall; buttresses to 60 cm tall. **Bark** greenish grey; inner bark pale fawn or pinkish. **Sapwood** pale cream. **Twigs** 2.5–6 mm diameter apically, deciduously tawny-pubescent to subglabrous. **Leaves** to 45 cm long, pseudogemmate; petioles 2–10 cm long, terete, minutely pubescent; leaflets dark green above, paler below, glabrous or sparsely pubescent (*hairs simple*) on veins; lateral leaflets to 9 on each side of rachis, opposite; blades elliptical to ovate-oblong, 16.5(–26.5) × 6(–9) cm, base more or less asymmetrical, acute to obtuse, apex acuminate to acutely cuspidate; lateral veins 8–16 on each side of midrib; petiolules to 8 mm long. **Inflorescences** spicate to thyrsoid, to 63 cm long, axillary to supra-axillary, sometimes in axils of unexpanded leaves; axes finely velvety-puberulous. **Flowers** pedicellate, more or less fragrant; calyx c. 4 mm tall, more or less sparsely puberulous outside, margin truncate to obscurely or irregularly lobed; petals (4 or) 5, 8–12(–18) × 2 mm, cream, densely fulvescent-hirsute outside, aestivation valvate, apex acute; staminal tube white, more or less densely pilose, rarely subglabrous inside, pubescent outside, margin 5-lobed, lobes lacinate, anthers 5 (or 6), c. 3 mm long, glabrous; ovary 2-locular, shortly stipitate, hirsute, style glabrous to pubescent. **Infructescences** to 30 cm long. **Fruits** globose or beaked, to 2.1 cm diameter, dull red, minutely rusty-tomentose (*hairs non-irritant*); pericarp with white latex. **Seeds** 2, to 15 mm diameter, flattened, sarcotestal.

Vernacular name. Sabah—*lisi-lisi* (preferred name).

Distribution. Peninsular Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, Nusa Tenggara, the Philippines and Maluku.

Notes. This species is represented by two distinct subspecies, *i.e.* subsp. *pentandrus* and subsp. *paucijugus* that are allopatric save in northern Borneo and Palawan (the Philippines), where, as pointed out by Mabberley (*op. cit.* 1979 and Mabberley *et al. op. cit.*), there are intermediate populations. Since the publication of the monograph, many more intermediate

collections have been made. Notable among these are those with spherical fruits on scarcely branched infructescences. In Sarawak, forms with the beaked fruits typical of subsp. *paucijugus* as found in Peninsular Malaysia have been collected from sites very close to those with spherical fruits. In Sabah, there are both the subsp. *paucijugus* form and form identical with typical *C. pentandrus* from the Philippines. Among the intermediates some were referred to subsp. *medius* Mabb. but with the torrent of intermediates linking subsp. *paucijugus* and subsp. *pentandrus*, the value of recognising that at subspecific rank is increasingly dubious. The polymorphic populations of these very commonly collected trees would make an interesting field study for undergraduates: are two species introgressing or are the extreme forms of the northern Borneo populations acting as distinct species elsewhere, e.g., Peninsular Malaysia? For the time being, a selection of specimens typical of the two ends of the range, i.e. subsp. *paucijugus* and subsp. *pentandrus*, are listed, as are a number of the intermediates under 'subsp. *medius*', until the matter is more fully resolved. It cannot be overstressed, though, that a great number, perhaps the majority, of specimens, especially from Sabah, presently in herbaria belong to the intermediate group. Needless to say, many specimens will be difficult to pigeonhole.

Key to subspecies

1. Fruit conspicuously beaked. Inflorescence more or less unbranched.....
 - subsp. **paucijugus** (Miq.) Mabb.
 - (Latin *paucus* = few, *jugum* = yoke; referring to the few leaflets)
 - Bull. Brit. Mus. Nat. Hist. Bot. 6 (1979) 366, *op. cit.* (1989) 238; Whitmore, Tantra & Sutisna *op. cit.* 228; Mabberley *et al. op. cit.* 183; Turner *op. cit.* 340; Coode *et al.* (eds.) *op. cit.* 203; Beaman & Anderson *op. cit.* 129. Basionym: *Schizochiton paucijugum* Miq. *op. cit.* (1868) 27 & 30. Syntypes: *Korthals s.n.*, Sumatra, Mt. Singgalang (U [Acc. No. 39425]); *Korthals s.n.*, Kalimantan, Mt Sakumbang and near R. Punay (U [Acc. No. 39425], L [Acc. No. 9081321114]). Synonyms: *Dasycoleum beccarianum* Baill., Adans. 11 (1874) 263; *Chisocheton paucijugus* (Miq.) B.D. Jackson, Ind. Kew. 1 (1893) 517, Merrill *op. cit.* (1921) 319, Masamune *op. cit.* 374; *Chisocheton beccarianus* (Baill.) Harms, *op. cit.* (1896) 296, Merrill *op. cit.* (1921) 319, *op. cit.* (1929) 122, Masamune *op. cit.* 374, Anderson *op. cit.* (1980) 250.
 - Small tree to 8 m tall. Twigs 2.5–3 mm diameter apically. Leaves to 45 cm long, with 3–5 (or 6) leaflets on each side of rachis; blades ovate-oblong, base cuneate, apex acutely cuspidate; lateral veins 8–12 on each side of midrib; petiolules 6–8 mm long. Inflorescences to 24 cm long, usually unbranched, bearing cymes of 1–few flowers; petals to 18 mm long. Infructescences with fruits borne at the tips. Fruits tapering at each end, the distal acute, proximal terete.
 - Peninsular Thailand, Sumatra, Peninsular Malaysia, Borneo and the Philippines (Palawan). In Sabah, recorded from Beaufort, Keningau, Kota Belud, Labuk Sugut, Lahad Datu, Ranau, Sandakan and Tawau districts (e.g., *SAN* 22542, *SAN* 49801, *SAN* 79499, *SAN* 84710, *SAN* 95797 and *SAN* 116937) and in Sarawak from Kuching, Lawas, Lundu, Marudi, Miri and Sri Aman districts (e.g., *S* 13402, *S* 24440, *S* 31541, *S* 47392, *S* 56604 and *S* 74321). Also known from Brunei (e.g., *Kirkup DK* 857) and Kalimantan (e.g., *Kostermans* 13460).
 - Wetter forests of W Malesia, including limestone.
- Fruit spherical. Inflorescence more or less branched.....2
2. Inflorescence branched to four orders; flowers to 8 mm long. Leaflet lateral veins *c.* 16 on each side of midrib.....

subsp. **pentandrus** Mabb.

Bull. Brit. Mus. Nat. Hist. Bot. 6 (1979) 364, *op. cit.* (1989) 237; Mabblerley *et al. op. cit.* 182; Turner *op. cit.* 340. Synonyms: *Chisocheton* sp., Merrill *op. cit.* (1929) 122.

Tree to 16(–40) m tall. Twigs 4–6 mm diameter apically. Leaflets: blades elliptical-oblong, base asymmetrical, obtuse or acute; lateral veins *c.* 16 on each side of midrib. Inflorescences branched to 3 or 4 orders; branches to 12 cm long; petals to 8 mm long. Fruits spherical, to 21 mm diameter, abruptly stipitate and minutely beaked; stipe to 8 mm long, 3 mm diameter.

Peninsular Malaysia (Johore), Java, Borneo, the Philippines, Sulawesi, Nusa Tenggara (Bali, Sumbawa, Flores) and Maluku (Halmahera, Ambon). In Borneo, known only in Sabah from Kudat, Lahad Datu, Ranau, Sandakan, Semporna and Tawau districts (e.g., *SAN* 28928, *SAN* 29410, *SAN* 29724, *SAN* 32550 and *SAN* 42120) and in Kalimantan (e.g., *Kostermans* 4892).

Drier lowland forest of west and central Malesia.

Inflorescence sparsely branched; flowers 8–16 mm long. Leaflet lateral veins *c.* 13 on each side of midrib.....

subsp. **medius** Mabb.

(Latin, *median* = intermediate; referring to its being intermediate between the other two subspecies)

Bull. Brit. Mus. Nat. Hist. 6 (1979) 365; Mabblerley *et al. op. cit.* 182; Coode *et al.* (eds.) *op. cit.* 203; Beaman & Anderson *op. cit.* 128. Type: *Mabblerley* 1676, Borneo, Sabah, Sandakan district, Sepilok FR (holotype FHO; isotypes K, L, SAN, SAR).

Small tree to *c.* 8 m tall. Intermediate in all features between subsp. *paucijugus* and subsp. *pentandrus*. Fruits globose.

Borneo and the Philippines (Palawan). In Borneo, known in Sabah from Beaufort, Keningau, Kinabatangan, Kota Belud, Kudat, Labuk Sugut, Lahad Datu, Pensiangan, Ranau, Sandakan, Semporna, Sipitang, Tawau and Tenom districts (e.g., *SAN* 40533, *SAN* 84710, *SAN* 93805, *SAN* 109960 and *SAN* 143513), in Brunei (e.g., *BRUN* 15009) and Kalimantan (e.g., *Kostermans* 6224). Not yet recorded from Sarawak.

Lowland rain forest. In the absence of fruits, it is difficult to assign some specimens. Such gatherings could represent either of the other two subspecies.

14. **Chisocheton polyandrus** Merr.

(Greek, *poly* = many, *andros* = man; an allusion to the many stamens in each flower)

Phil. J. Sci. Bot. 21 (1922) 520; Mabblerley *op. cit.* (1979) 324; Whitmore, Tantra & Sutisna *op. cit.* 229; Mabblerley *et al. op. cit.* 144; Coode *et al.* (eds.) *op. cit.* 203; Beaman & Anderson *op. cit.* 129.

Syntypes: *Wood* 657, Sabah, Sandakan, Labuk (PNH†; isosyntypes A, K) and *Ramos* BS 1217, Batu Lima (PNH†; isosyntype A).

Tree to 15 m tall, unbranched or very sparsely branched, occasionally with stiltroots or small buttresses. **Bark:** inner bark pinkish. **Sapwood** fawn. **Leaves** to 150 cm long, *imparipinnate* or *pseudogemmulate*, when pseudogemmula densely long-pubescent (*hairs simple*); *petioles* 1–5 cm long, terete, woody; rachis terete; lateral leaflets shiny, bullate at altitude, *glabrous* or *veins more or less pubescent (hairs simple)* above, *appressed hirsute* below, particularly at high altitudes; lateral leaflets to 14 on each side of rachis, opposite or subalternate at base of rachis, where they are often very small and even irregularly lobed; blades oblong-lanceolate, 11–43 × 5–13 cm, *base asymmetrical, cuneate to subcordate*, apex somewhat

acuminate; *lateral veins* *c.* 15 on each side of midrib, often sunken above; *petiolules* to 2 mm long. **Inflorescences** borne in upper leaf axils, up to 4 at a time, to 200 cm long, unbranched or with a few squarrose branches to 13 cm long near tip, where flowers are condensed; axes *ferruginous-pubescent when young*. **Flowers:** *calyx* cup-shaped to subcylindrical, 5–8 × 5–6 mm, densely ferruginous-pubescent, green to deep red, margin truncate; *petals* 5 or 6, subspathulate, 28–32 mm long, fleshy, creamy-white with conspicuous pink or red tinge, *densely pubescent outside*; *staminal tube* cylindrical, white, subglabrous save for the conspicuous bands of hairs apically and basally inside, *margin with 12–14 linear lobes*, *c.* 3 mm tall, *anthers* 12–14, *c.* 4 mm long, *locellate*, connective sparsely ferruginous-pubescent; disc *c.* 1 mm tall, thick, glabrous, margin truncate; ovary ?3–5-locular, style cylindrical, glabrous, stylehead subcapitate, *c.* 1 mm diameter. **Infructescence** to 200 cm long, pendent, with fruits aggregated at tip. **Fruits** spherical, *c.* 2.5 cm diameter, *covered with reddish irritant hairs*, splitting into 3 or 4 valves. **Seeds** 3; testa black, covered on inner surface by orange-red aril.

Distribution. Endemic in Borneo. In Sabah, known from Beaufort, Keningau, Kinabatangan, Kota Belud, Kudat, Labuk Sugut, Pensiangan, Pitas, Ranau, Sandakan, Tawau and Tenom districts (e.g., *Mabberley 1688*, *SAN 42075*, *SAN 49763*, *SAN 76067* and *SAN 82406*) and in Sarawak from Kapit, Kuching, Lawas and Miri districts (e.g., *S 31130*, *S 31533*, *S 43683*, *S 49549* and *S 56406*). Also occurring in Brunei (e.g., *BRUN 349*) and Kalimantan (e.g., *Chai P.K. ITTO/BA 196* and *Kuswata 703*).

Ecology. Mixed dipterocarp forest, at 150–300 m altitude.

15. *Chisocheton ruber* Ridl.

(Latin, *ruber* = red; the flowers)

Bull. Misc. Inform. Kew (1930) 365; *Mabberley op. cit.* (1979) 342; *Anderson op. cit.* (1980) 251; Whitmore, Tantra & Sutisna *op. cit.* 229; *Mabberley et al. op. cit.* 160. **Type:** *Haviland 594*, Borneo, Sarawak, Kuching district, Padawan, G. Braang (holotype K; isotype SAR).

Tree to 15 m tall; bole to 20 cm diameter, fluted. **Bark** smooth to weakly and irregularly flaking, greenish grey or reddish, with conspicuous inflorescence bosses, sometimes bearing leafy shoots, arranged more or less spirally from ground level to 5 m. **Sapwood** ivory. **Twigs** 12–15 mm diameter apically. **Leaves** to 150 cm long, *pseudogemmulate*, subglabrous, in terminal spirals; *petioles* 8–20 cm long; rachis somewhat 3-ribbed; leaflets coriaceous, brilliant carmine when young and appearing in flushes of up to 11 pairs at once, very sparsely puberulous; lateral leaflets to 15 on each side of rachis, opposite; *blades oblong*, to 42 × 10 cm, *base* subacute, *strongly asymmetrical*, apex acuminate; lateral veins 12–14 on each side of midrib; intercostal venation conspicuous below; *petiolules* *c.* 6 mm long. **Inflorescences** to 12 cm long, not or once branched, borne near base of bole, on bosses that produce them over several seasons; rachis pubescent. **Flowers** sweetly scented; pedicels 1–3 mm long, pubescent, minutely bracteolate; *calyx* cup-shaped, *c.* 4 mm tall, rugose, pubescent, red, *margin more or less 4- or 5-lobed*; *petals* 5 or 6, linear-oblong to spathulate, 20–22 mm long, *c.* 4 mm wide at widest, *c.* 2.5 mm at narrowest, fleshy distally, pubescent outside, aestivation imbricate to quincuncial, *outside pink, becoming red towards apex*, white inside; staminal tube pubescent distally outside, villous inside, white, adnate to corolla at base, margin shallowly 6–8-lobed, each lobe praemorse or irregularly 2- or 3-fid, *anthers* 8–10, oblong, *c.* 2 mm long, *non-locellate*, yellow, sparsely hairy near connective,

basifixed; disc obscure; ovary conical, 5-locular, appressed pubescent, style white, hairy in proximal 3/4 or throughout, stylehead very shortly cylindrical to subdiscooid, to 1.8 mm diameter. **Fruits** top-shaped when young, to 5×5 cm, stipitate, *glabrous*, reddish brown; pericarp with white latex. **Seeds** bean-shaped (when dry), *c.* 2 cm long.

Distribution. Endemic in Borneo and known only in Sarawak from Bau and Serian districts (e.g., *Mabberley 1635, S 37440, S 39274, S 49252, S 50328 and S 75808*).

Ecology. Restricted to forest on limestone formation, at 80–250 m altitude.

16. *Chisocheton sarasinorum* Harms

(Karl Friedrich Sarasin (1859–1942) and Paul Benedkt Sarasin (1856–1929), Swiss gentlemen, zoologists and explorers)

In Fedde, Rep. 42 (1937) 8; Mabberley op. cit. (1979) 356; Whitmore, Tantra & Sutisna op. cit. 229; Mabberley et al. op. cit. 172. Type: K.F. & P. B. Sarasin 2137, Sulawesi, near Bada (holotype B†; isotype not located).

Treelet or small tree to 15 m tall with open crown. **Bark** smooth greyish green; inner bark pale brown. **Sapwood** pale fawn. **Twigs** rather rough, brown, with vertical lenticels, *c.* 8 mm diameter apically. **Leaves** to 150 cm long, *pseudogemmate*, dull above, pale below, in terminal spirals; *rachis* green, subglabrous to *weakly pilose (hairs simple)*; petioles to 20 cm long or more, subglabrous to weakly pilose; *leaflets* glabrous or *subglabrous when sparsely pubescent on veins (hairs simple)*; lateral leaflets to 7 on each side of rachis, opposite; blades oblong or oblong-lanceolate, $10\text{--}28 \times 3.5\text{--}10$ cm, base acute or weakly obtuse, apex acuminate; lateral veins *c.* 15 on each side of midrib, prominent and pale below when dry; petiolules to 15 mm long, sometimes pubescent. **Inflorescences** to 35 cm long, *axillary to supra-axillary*, narrow, sparsely branched; most proximal branches to 14 cm long, ascendant, weakly pilose to subglabrous, each with 1–4 flowers. **Flowers:** pedicels 2–3 mm long, stout; *calyx* shallowly cup-shaped, $5\text{--}6 \times 7\text{--}8$ mm, densely tomentose outside, margin truncate to obscurely undulate; *petals (5 or) 6 in 2 ranks*, white, adhering to tube at base, *3 outer petals narrowly oblong, $16\text{--}20 \times 6$ mm, obtuse, (2 or) 3 inner ones almost linear, $14\text{--}18$ mm long, obtuse, apex hooded*; staminal tube thick, tough, white, glabrous to subglabrous outside, laxly pilose proximally inside, margin truncate to obscurely dentate, anthers 8–10 (or 11), linear, 2–2.5 mm long, basifixed, included; ovary 6–8-locular, densely villous, style villous in proximal half, stylehead discoid to stoutly cylindrical. **Fruits** flattened globose, beaked when young, to 7×8 cm, 6–8-locular, borne singly or paired on rachis to 20 cm long, 8 mm diameter; pericarp *c.* 4 mm thick, tough, *greenish brown velutinous (hairs non-irritant)*, exuding white latex on damage. **Seeds** to 5 cm long, like an orange-segment; sarcotesta vascularised.

Distribution. Borneo and Sulawesi. In Sabah, recorded from Keningau, Kota Belud, Pensiangan, Ranau and Sandakan districts (e.g., *Lugas 2697, SAN 29528 and SAN 66291*) and in Sarawak from Belaga, Kapit, Lawas, Lubok Antu and Marudi districts (e.g., *S 31577, S 41507, S 43626, S 46925 and S 68179*). Also known in Brunei (e.g., *BRUN 17630*) and Kalimantan (e.g., *Kostermans 21485*).

Ecology. In swampy and hill rain forest, at altitudes to 1150 m.

Notes. The leaves closely resemble those of *Chisocheton ceramicus* and sterile material may be readily confused, though when dry that of *C. sarasinorum* has a rather more sickly pallor.

17. *Chisocheton sarawakanus* (C.DC.) Harms
(from Sarawak)

Fig. 16.

In Engler & Prantl, Nat. Pflanzenfam. 3, 4 (1896) 296; Merrill *op. cit.* (1921) 320; Masamune *op. cit.* 375; Anderson *op. cit.* (1980) 251; Mabberley *op. cit.* (1979) 342, *op. cit.* (1989) 238, *op. cit.* (1995) 161; Whitmore, Tantra & Sutisna *op. cit.* 230; Mabberley *et al. op. cit.* 161; Turner *op. cit.* 340; Coode *et al.* (eds.) *op. cit.* 204; Argent *et al.* (eds.) *op. cit.* 416. **Basionym:** *Dasycoleum sarawakanum* C. DC. *op. cit.* (1878) 541. **Type:** Beccari 3186, Borneo, Sarawak (holotype K). **Synonyms:** *Chisocheton brachyanthus* Merr. *op. cit.* (1922) 315, *op. cit.* (1929) 122, Masamune *op. cit.* 374; *Chisocheton glomeratus* auct. non Hiern (1875): Meijer, Bot. News Bull. Sabah 8 (1967) 79.

Tree, 5–20 m tall; bole to 30 cm diameter, fluted below, with small buttresses to 2 m tall. **Bark** fawn to chocolate, smooth to weakly flaking; inner bark brownish yellow. **Sapwood** white to pale fawn. Innovations more or less pale ferruginous-pubescent. **Twigs** terete, dark brown, *non-lenticellate*, *without distinct petiole scars*, glabrous when leafless, *c.* 5 mm diameter apically, rarely myrmecophilous. **Leaves** to 200 cm long, *pseudogemmulate*, *pseudogemmula not markedly circinate*; petioles 5–12 cm long; rachis brown, pubescent to ultimately glabrous; leaflets subcoriaceous, shiny and glabrous on both surfaces to ferruginous-pubescent (*hairs simple*) below, particularly on veins, and on veins above; *lateral leaflets to 26 on each side of rachis*, opposite, flushing in up to 3 pairs at a time; *blades elliptical to elliptical-oblong*, 8–29 × 4–8 cm, base slightly narrowed or rounded, sometimes asymmetrical, *apex rather abruptly caudate-acuminate with acumen to 2 cm long*; *lateral veins 10–14 on each side of midrib*, spreading, depressed above and prominent below when dry; *petiolules c.* 6 mm long, pubescent. **Inflorescences** to 50 cm long, narrowly panicle or subspicate, *supra-axillary*; primary branches few, squarrose, bearing few secondary branches of cymules, with the flowers usually borne in pairs, sessile. **Flowers** sweetly scented; *calyx* cup-shaped, 2–3 × 1.8 mm, glabrous to puberulous outside, glabrous inside, margin truncate to obscurely crenate; *petals 4, linear, c.* 12 × 1.8 mm, white, drying black, puberulous outside, glabrous inside, *aestivation imbricate*, apex obtuse, slightly concave; *staminal tube* cylindrical, *c.* 2 mm diameter, somewhat appressed hairy distally, *margin crenate*, *anthers* (3 or) 4–6, 1–2 mm long, inserted just below rim, *somewhat ciliate posteriorly*; *disc absent*; *ovary 2-locular*, appressed pubescent, style pubescent proximally, *stylehead subcapitate, c.* 0.5 mm diameter. **Infructescences** with branches to 6 cm with up to 8 fruits on each. **Fruits** depressed globose, *c.* 4 cm diameter, shortly stipitate, crimson, obovoid and *densely ferruginous-pubescent when young (hairs non-irritant)*; pericarp sometimes with white latex. **Seeds** 2; testa dark brown, *partly enveloped by aril*.

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Sabah, known from Beaufort, Kinabatangan, Kota Kinabalu, Ranau, Sandakan, Semporna and Tawau (e.g., Mabberley 1646, SAN 54462, SAN 57196, SAN 66873, SAN 67192 and SAN 83010) and in Sarawak from Betong, Kapit, Lawas, Lundu, Miri, Serian and Sri Aman districts (e.g., Pennington 8013, S 18476, S 31542, S 39190 and S 44007). Also known in Brunei (e.g., Forman 1182) and Kalimantan (e.g., Veldkamp 8506).

Ecology. A commonly collected tree of rain forest at altitudes to 250 m.

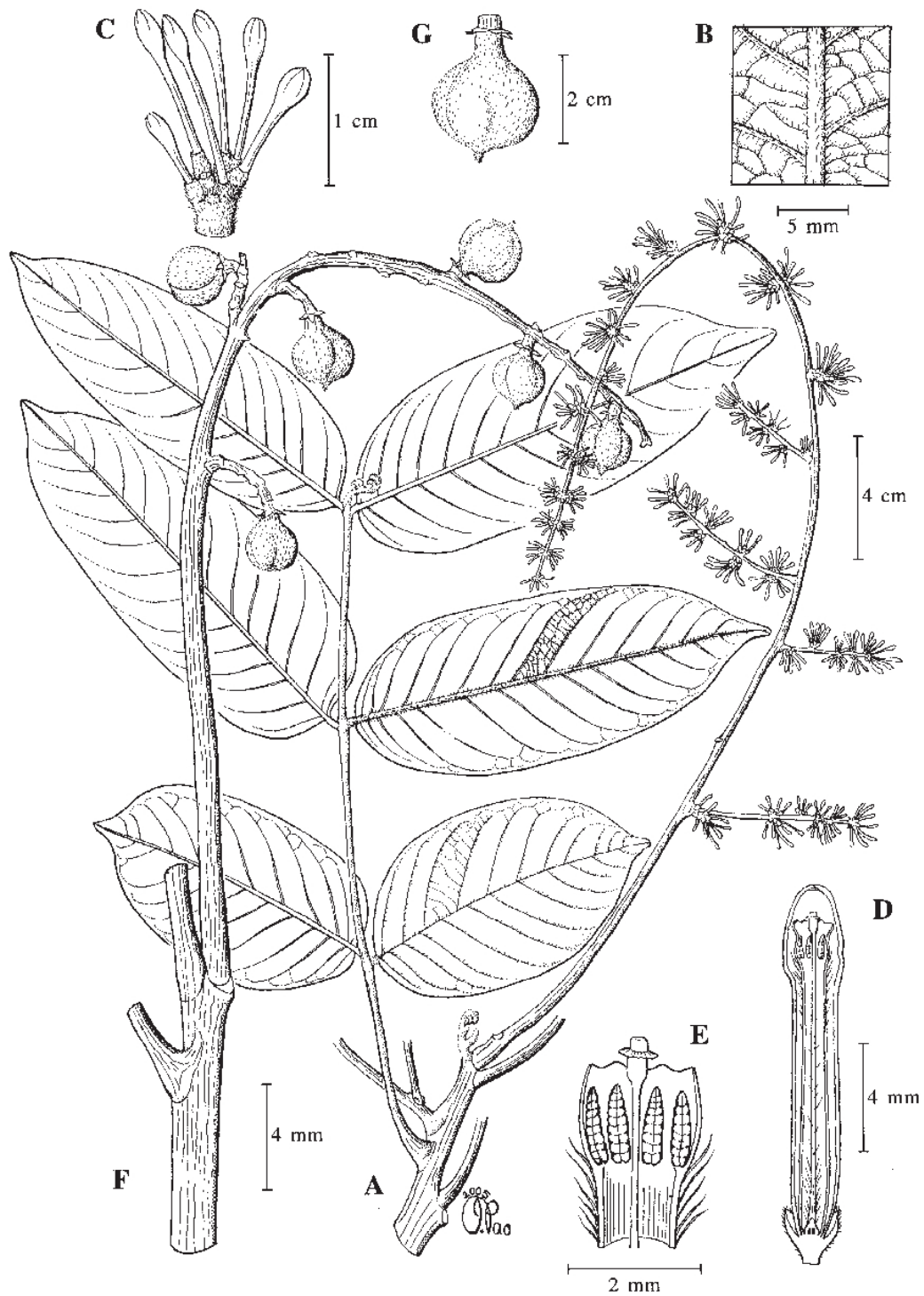


Fig. 16. *Chisocheton sarawakanus*. A, flowering (male) leafy twig; B, detail of leaflet lower surface showing venation and indumentum; C, fascicle of male flowers; D, longitudinal section of male flower; E, distal adaxial side of staminal tube showing stamens and style and stylehead; F, infructescence; G, fruit. (A–E from SAN 21476, F–G from SAN 85475.)

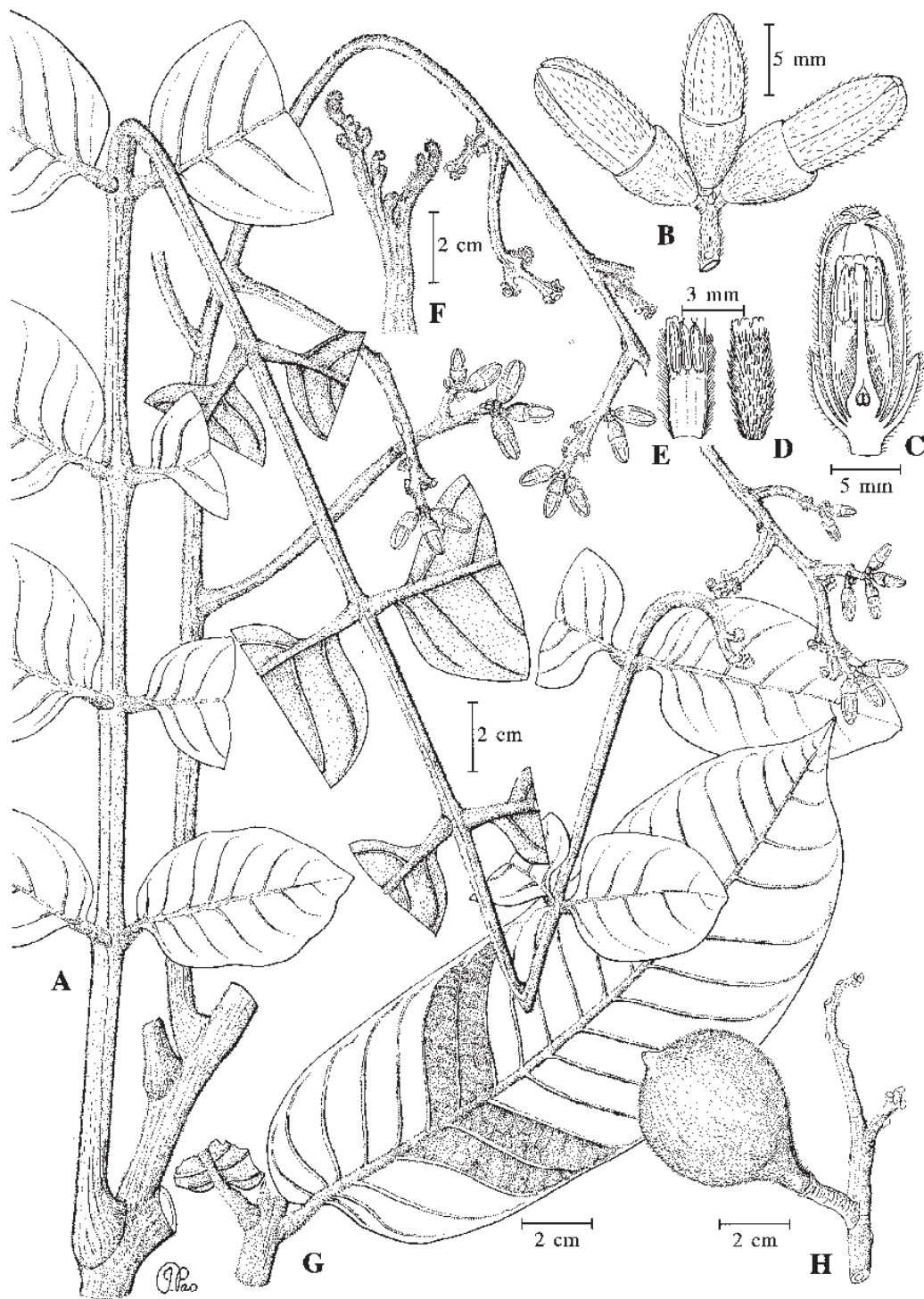


Fig. 17. *Chisocheton velutinus*. A, flowering (female) leafy twig; B, distal fascicle of female flowers; C, longitudinal section of female flower; D, abaxial side of staminal tube; E, adaxial side of staminal tube; F, apical young shoot with developing leaflets; G, older leaflet; H, fruit. (A–E from Wong WKM 1536, F–H from Kirkup et al. DK 940.)

Notes. There is a complete gradation between the more or less glabrous and hairy forms, the latter being readily distinguished from hairy forms of *Chisocheton patens* in Borneo, where they occur together, by their prominent leaf venation.

18. *Chisocheton setosus* Ridl.

(Latin, *setosus* = beset with bristly hairs)

Bull. Misc. Inform. Kew (1930) 366; Mabblerley *op. cit.* (1979) 327; Anderson *op. cit.* (1980) 251; Whitmore, Tantra & Sutisna *op. cit.* 230; Mabblerley *et al. op. cit.* 146; Coode *et al.* (eds.) *op. cit.* 204. **Type:** *Haviland 598*, Borneo, Sarawak, Limbang district (holotype K [photo FHO]; isotypes ?BM, SAR).

Treelet to 5.5 m tall, ?unbranched; bole *c.* 8 cm diameter. **Bark** smooth; inner bark pale yellow. **Twigs** *c.* 1 cm diameter apically, densely ferruginous-setose. **Leaves** to 100 cm long, imparipinnate; *petioles* to 35 cm long, subterete, sometimes grooved adaxially, to 6 mm diameter, ferruginous-setose, hairs 2–3 mm long, base swollen with conspicuous hollow at junction with shoot; rachis 1- or 2-sulcate, setose as petioles; *leaflets* more or less densely ferruginous-setose on both sides, dry *setae* tinkling when stroked, pale when dry; lateral leaflets at least 6 on each side of rachis, opposite; *blades* of proximal leaflets elliptical-oblong, to 20 × 8.5 cm, that of distal leaflets oblanceolate to oblong, to 36 × 10 cm, *base rounded to attenuate, symmetrical*, apex acuminate, acumen 10–20 mm long; *lateral veins* 17–20 on each side of midrib, prominent below; intercostal venation somewhat prominently scalariform; *petiolules* 5–6 mm long, densely tomentose, *that of terminal leaflets* to 10 mm long. **Inflorescences** to 200 cm long, *axillary or extra-axillary*, pendulous, *more or less densely setose*, drying irregularly angled with flowers crowded in condensed cymes at distal end like a bellrope; bracts *c.* 7 mm long, setose. **Flowers** recurved, shortly pedicellate; *calyx* cup-shaped, *c.* 3 × 4 mm, somewhat elongated into a pseudopedicel, reddish, setose to pubescent, margin truncate to obscurely 3- or 4-lobed; corolla weakly clavate, 3–3.5 × 0.3 cm, glabrous, white or greenish, *petals* 4–6, subspathulate, to 32 (or longer) × 4 mm, glabrous, imbricate at apex; *staminal tube* to 3.2 cm tall, glabrous except for a band of hairs below lobes outside, white, *margin with 6–8 truncate lobes* or irregularly lobed, *anthers* 6–8, *c.* 2 mm long, glabrous, *scarcely locellate*; disc cupular, *c.* 1 mm tall, glabrous, margin truncate to obscurely lobed; ovary in female flowers unknown, style sparsely pilose proximally, glabrous distally, stylehead capitate, distinctly narrow-annular apically. **Fruits** (unripe) pale yellow, *densely setose*.

Distribution. Endemic in Borneo. Known in Sabah from Beaufort, Ranau and Sandakan districts (e.g., *SAN 30162*, *SAN 34282* and *SAN 90226*) and in Sarawak from Mt. Dulit, Marudi district (e.g., *Richards 2539*). Also occurring in Kalimantan (e.g., *Mogea 3636*). Not yet recorded from Brunei.

Ecology. Presumably rain forest.

19. *Chisocheton velutinus* Mabb.

Fig. 17.

(Latin, *velutinus* = velvety; the indumentum of leaves and fruits)

Gard. Bull. Sing. 55 (2003) 192. **Type:** *Wong WKM 1536*, Borneo, Brunei, Temburong district, Bt. Belalong (holotype SAN; isotypes KEP, SAR). **Synonym:** *Chisocheton* sp. B., Mabblerley *op. cit.* (1979) 372, Mabblerley *et al. op. cit.* 186., *p.p.*, *quoad specim. S 21307 et S 28793*.

Tree to 25 m tall; bole to 35 cm diameter with small buttresses. **Bark** smooth, medium brown to greyish, hoop-marked; inner bark pinkish to red-brown. **Sapwood** straw. **Twigs** 1.2–2.5 cm diameter apically, fawn-pubescent. **Leaves** to 100 cm long, pseudogemmulate; petioles 10–15 cm long, more or less angled, like rachis, fulvo-velutinous; leaflets minutely pubescent on sunken midrib, *densely velutinous below (hairs simple)*; lateral leaflets to at least 12 on each side of rachis, opposite; blades oblong, to 24 × 9 cm, base asymmetrical, rounded, apex shortly acuminate; lateral veins 15–17 on each side of midrib, spreading, rather prominent above (when dry); petiolules to 9 mm long. **Inflorescences** to 40 cm long, axillary or extra-axillary, paniculate, velutinous; branches rather distant, to 13 cm long, ultimate branchlets cymulose, few-flowered. **Flowers:** pedicels densely pubescent; calyx cup-shaped, *c. 6 mm tall*, pubescent, green, *margin very obscurely 4-lobed to truncate*; petals 4 (or 5), linear-spathulate, to 16 mm long, aestivation valvate, puberulous to pubescent outside, glabrous inside, cream; staminal tube cream, weakly adherent to petals at base, more or less hairy outside, *6–8-lobed, lobes 2-toothed to 1 mm long*, anthers 6–8, oblong, *c. 3 mm long*, locellate, basifixed, apices within the tube; disc obscure; ovary 4-locular, sericeous, style more or less glabrous, stylehead shortly cylindrical. **Infructescences** to 30 cm long, axillary or on twigs behind leaves. **Fruits** globose, *c. 5 cm diameter* (immature), rostrate when young, *velutinous (hairs non-irritant)*, yellow turning red. **Seeds** (immature) 2.

Distribution. Endemic in Borneo. Known in Sarawak from Kapit and Miri districts (e.g., *S 21307* and *S 28793*) but not yet recorded from Sabah. Also occurring in Brunei (e.g., *Kirkup DK 940*) and Kalimantan (e.g., *Kostermans 10024* and *Kostermans 10558A*).

Ecology. Rain forest at altitudes to 650 m.

Incompletely known species

Chisocheton sp. B

Mabberley *op. cit.* (1979) 372; Mabberley *et al. op. cit.* 186, *p.p.*, *quoad specim. S 25844*.

Tree, 12–14 m tall; bole *c. 20 cm diameter*. **Leaves** to 40 cm long; leaflet blades to 17 × 8 cm, bluntly long-acuminate, brown velutinous below, weakly pubescent on veins above; lateral veins *c. 15* on each side of midrib. **Inflorescences** supra-axillary, *c. 70 cm long*, branches to 22 cm long, all brown long-tomentose (flowers very immature). **Flowers:** calyx irregularly lobed; petals 5; anthers 5, locellate; disc absent; style glabrous. **Fruits** densely brown-tomentose.

Distribution. Known in Sarawak only from one flowering (buds only) specimen (*S 25844*) from Bt. Salong, Ulu Sapurau, Kapit district (K, SAR), and one fruiting specimen (*S 45515*) from Sg. Iban, Belaga district (SAR). Other (fruiting) specimens cited by Mabberley (*op. cit.* 1979) belong to *Chisocheton velutinus* Mabb. (*q.v.*).

Ecology. Ridge forest at altitudes above 1100 m.

Chisocheton *sp. nov. aff. diversifolius* Miq.

Mabberley, Gard. Bull. Sing. 55 (2003) 194.

Treelet to 4 m tall with delicate twigs. **Leaves** with 7 lateral leaflets on each side of rachis; blades multi-veined, very narrow (5–6x as long as wide). Fruiting rachis very delicate, to 20 cm long. **Fruits** pubescent, spherical, 3–4 cm diameter.

Distribution. Known in Sarawak from a single fruiting specimen (*S 48450*) from Bt. Melatai, Batang Balleh, Kapit district (FHO, SAR).

5. CHUKRASIA A.Juss.

(from the Bengali name, *chikrassee*)

surian batu (standard ASEAN and Malaysian trade name)

Bull. Sci. Nat. Géol. 23 (1830) 239; Pennington & Styles, Blumea 22 (1975) 519; Anderson, CLTS (1980) 251; Mabberley *in* Mabberley & Pannell, TFM 4 (1989) 254; Mabberley *et al.*, FM 1, 12 (1995) 354; PROSEA 5, 2 (1995) 127. **Synonyms:** *Chickrassia* Wight & Arn., Prodr. (1834) 122 *nom. superfl.*; Hiern *in* Hooker *f.*, Fl. Brit. Ind. 1 (1875) 567; King, J. As. Soc. Beng. 64, 1 (1895) 88; Ridley, FMP 1 (1922) 415.

Deciduous trees. **Indumentum** of simple hairs. **Bud scales** present. **Leaves** *paripinnate with terminal spike, imparipinnate and bipinnate* with incised or lobed leaflets in juveniles, rarely retained at maturity, *without pseudogemmula; leaflets more than 8 on each side of rachis*, opposite. **Inflorescences** axillary thyrses, often subterminal appearing terminal. **Flowers** unisexual; calyx 4- or 5-lobed; petals 4 or 5, *12–16 mm long*, free, contorted and much longer than calyx in bud; staminal tube cylindrical, somewhat narrowing distally, margin entire to crenulate, anthers attached to margin; disc obscure to narrowly cushion-shaped; ovary flask-shaped, 3–5-locular, each locule with numerous ovules, stylehead capitate with 3–5 stigmatic ridges. **Fruits** ovoid or ellipsoid, woody capsules, opening by 3–5 valves from the apex, the valves splitting into an outer and inner bifid layer; columella with 3–5 sharply angled ridges, extending to apex of capsule; seed-scars conspicuous. **Seeds** 60–100 per locule, wings terminal, arranged laterally in tiers in two ranks; endosperm present; embryo with subcircular cotyledons; radicle obliquely exerted. Germination phanerocotylar; eophylls opposite, irregularly imparipinnate, the leaflets lobed or irregularly toothed.

Distribution. One somewhat variable species from India and Sri Lanka, eastwards through tropical Asia to W Malesia.

Chukrasia tabularis A.Juss.

F i g . 1 8 .

(Latin, *tabularis* = flattened; referring to the seeds)

Bull. Sci. Nat. Géol. 23 (1830) 241; Anderson *op. cit.* (1980) 251; Mabberley *op. cit.* (1989) 256; Mabberley *et al. op. cit.* 355; PROSEA 5, 2 (1995) 127; Turner, Gard. Bull. Sing. 47 (1995) 340.

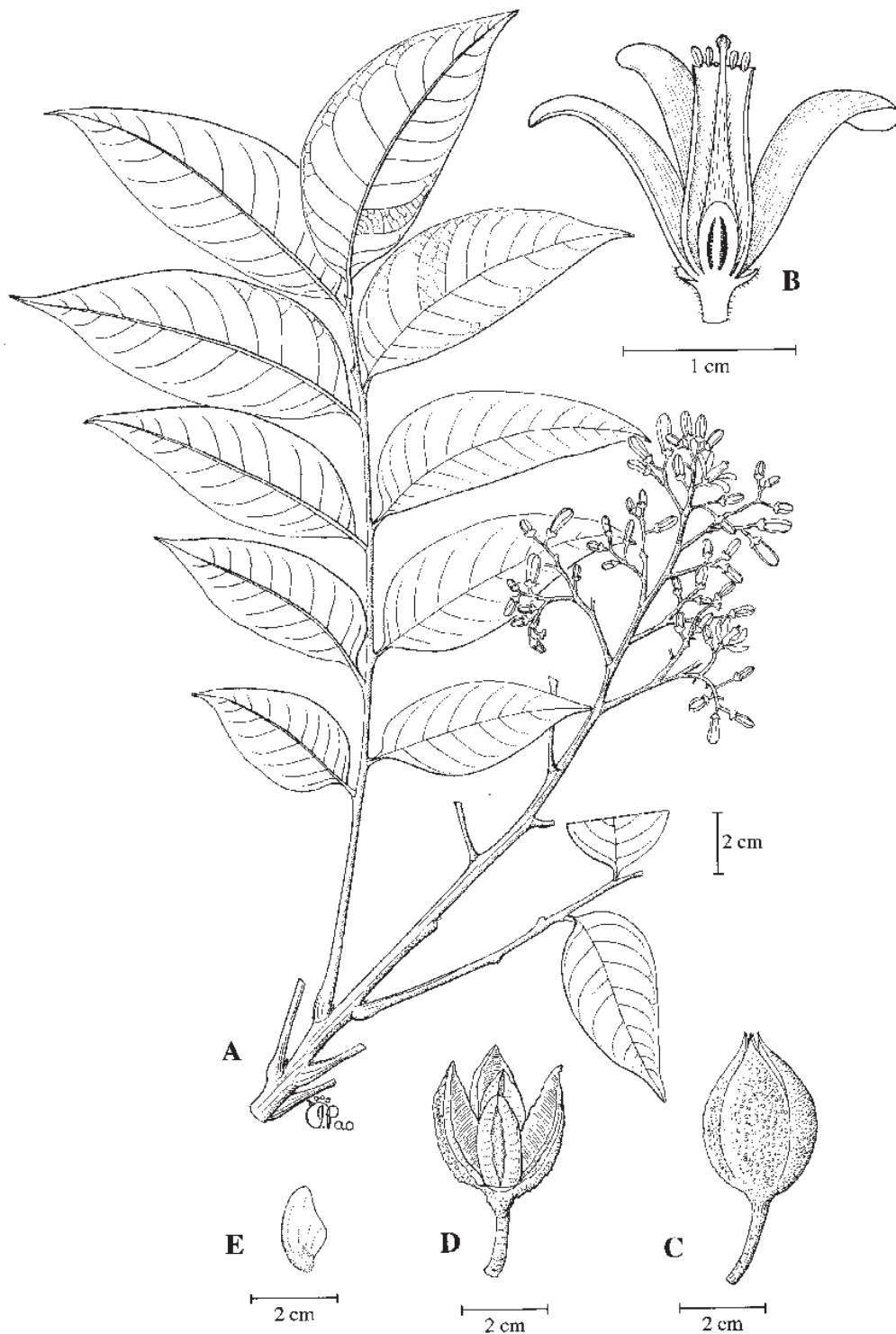


Fig. 18. *Chukrasia tabularis*. A, flowering leafy twig; B, longitudinal section of flower; C, fruit; D, dehiscent fruit; E, seed. (A from *Mabberley 1633*, B from *S 20274*, C–E from *S 22093*.)

Type: *Roxburgh s.n.*, India (holotype P, *n.v.*; isotype BM). **Synonym:** *Chickrassia tabularis* (A. Juss.) Wight & Arn., Prodr. (1834) 123, Hiern *op. cit.* 568, King *op. cit.* 88, Ridley *op. cit.* (1922) 415. (For complete synonymy, *cf.* Mabberley *et al. op. cit.*)

Tree to 40 m tall; bole to 25 m tall, fluted below, to 120 cm diameter; buttresses convex, to 1.5 m tall. **Bark** dark brown, fissured vertically and scaling or cracking into rectangular blocks; inner bark red-brown or pinkish. **Sapwood** straw; heartwood yellow to reddish brown. **Twigs** grey, bark cracking horizontally, 4–6 mm diameter apically, lenticellate. **Leaves** 30–50 cm long; petioles 4–9 cm long, more or less terete, swollen at base; leaflets chartaceous to subcoriaceous, more or less asymmetrical or even falcate, the subapical the largest, upper surface subglabrous to finely scattered short-pubescent, lower surface subglabrous except for short hairs on veins and domatia in axils of lateral veins; lateral leaflets 6–12 on each side of rachis, alternate; blades ovate to oblong, 10–17.5 × 3.5–6.5 cm, the most proximal as small as 4 × 2.2 cm, base obtuse to rounded distally, acute to cuneate proximally, apex acute to acuminate; lateral veins (in largest leaflet) 9–11 on each side of midrib, arcuate, more or less bifurcating near margin; petiolules 2–6 mm long. **Inflorescences** 10–30 cm long, primary branches to 16 cm long, secondary branches to 4 cm long, bearing fascicles of flowers; axes short-pubescent; bracts narrowly triangular, 2–7(–10) mm long, often caducous. **Flowers** sweetly scented; bracteoles similar to bracts but smaller; pedicels 3–4 mm long, articulated with pseudopedicels *c.* 2 mm long, continuous with calyx; calyx shallowly cup-shaped, 2.5–3.5 mm diameter, more or less pubescent outside, lobes obtuse, *c.* 1/3 the length of calyx; petals narrowly oblong to subspathulate, 12–16 mm long, creamy-green or yellowish, often tinged pink, subglabrous or puberulent (especially on sectors exposed before anthesis); staminal tube glabrous, colour as petals, anthers oblong, *c.* 1 mm long; ovary densely appressed pubescent. **Infructescence** pendulous with up to 6 fruits. **Fruits** (2.5–)3.5–5 × 2.5–4 cm, dark brown, lenticellate. **Seeds** *c.* 1.2 cm long.

Distribution. India and Nepal, east and southeastwards from S China (including Hainan), Sri Lanka and the Andaman Islands to Sumatra (north but rare), Peninsular Malaysia (but not in the south) and Borneo. In Borneo, known only in Sarawak and recorded from Bau and Serian districts (e.g., *Jacobs 5171*, *Mabberley 1640*, *S 12520*, *S 22093*, *S 28037* and *S 31612*).

Ecology. Rain forest and semi-deciduous forest, including bamboo forests and those on limestone, at altitudes to 900 m. In Sarawak, the species is locally frequent in forest on limestone hills, often associated with igneous-derived soils (Anderson *op. cit.*). It is a colonist of bare ground, including road cuttings in Peninsular Malaysia and tropical Australia where it has been introduced.

Uses. The timber is an export of Myanmar and India and is known in world commerce as *chickrassy*, *yinma* or Chittagong wood. It may be coppiced and it has been tried in tropical Australian plantations, but it is susceptible to the depredations of *Hypsipela* moths. It yields a gum that is marketed mixed with others in India, while the flowers are the source of a yellow or red dye. The bark is astringent. An extract from the twigs has proved an efficacious antifeedant against caterpillars of *Pieris rapae* in S China. In ASEAN countries, the timber is commonly used for interior finishing, panelling, moulding, flooring, decorative furniture, handicrafts, sliced veneer, and also suitable for medium to heavy, under cover construction work. (For details, *cf.* PROSEA 5, 2 (1995) 127 and Wong, T.M. (revised by S.C. Lim & R.C.K. Chung, 2002). A dictionary of Malaysian Timbers, 2nd ed., Mal. For. Rec. 30: 33 & 171.)

Notes. The trees from Sarawak (and Peninsular Malaysia) are almost glabrous, whilst in Sumatra both this form and a densely pubescent one have been collected. In SE Asia pubescence is correlated with bark form and other characters, indicating some ecogeographical morphological variation within the species there (Kalingire *et al.*, Austr. J. Bot. 50 (2002) 319).

6. DYSOXYLUM Blume

(Greek, *dys* = unpleasant, *xylon* = wood; referring to the foetid tissues of some species)

jarum-jarum (Malay), *membalun* (standard ASEAN trade name), *segera* (Iban)

Bidjr. Fl. Ned. Ind. (1825) 172; Hiern in Hooker *f.*, Fl. Brit. Ind. 1 (1875) 546; King, J. As. Soc. Beng. 64, 1 (1895) 36; Merrill, EB (1921) 320, Enum. Philip. Pl. 2 (1923) 562, PEB (1929) 120; Ridley, FMP 1 (1922) 390; Masamune, EPB (1942) 375; Backer & Bakhuizen *f.*, FJ 1 (1964) 121; Pennington & Styles, Blumea 22 (1975) 504; Anderson, CLTS (1980) 251; Corner, WSTM 3rd. ed. 2 (1988) 499; Mabberley in Mabberley & Pannell, TFM 4 (1989) 239, Blumea 38 (1994) 303, PB 2nd. ed. (1997) 246; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 230; Mabberley *et al.*, FM 1, 12 (1995) 61; Coode *et al.* (eds.), CLBD (1996) 204; Argent *et al.* (eds.), MNDT-CK 2 (1997) 416; PROSEA 5, 3 (1998) 197; Beaman & Anderson, PMK 5 (2004) 129. **Synonyms:** *Epicharis* Blume *op. cit.* (1825) 166; *Didymocheton* Blume *op. cit.* (1825) 177; *Goniocheton* Blume *op. cit.* (1825) 177; *Hartighsea* A.Juss., Bull. Sci. Nat. Géol. 23 (1830) 237; *Prasoxylon* M.J.Roem., Fam. Nat. Syn. Monogr. (1846) 83, 101, *nom. superfl.*; *Macrocheton* (Blume) M.J.Roem. *op. cit.* 84, 104 ('*Macrochiton*'); *Piptosaccos* Turcz., Bull. Soc. Nat. Mosc. 31 (1858) 415; *Alliaria* Kuntze, Rev. Gen. 1 (1891) 108, *nom. superfl.*, *non* Fabr. (1759). (For further synonymy *cf.* Mabberley *et al. op. cit.*)

Trees or shrubs, often very pachycaul, usually dioecious. **Indumentum** of simple hairs, very rarely with stellate ones. **Bud scales** absent. **Leaves** in spirals, rarely opposite, *pinnate*, occasionally with tardily developed apical leaflets. **Inflorescences** *thyrsoid*, *racemose* or *spicate*, sometimes reduced to fascicles or solitary flowers, axillary, on twigs or bole. **Flowers** unisexual, rarely bisexual; calyx tubular, 3–5(or 6)-lobed; *petals* 3–6, free or adnate to base of staminal tube; staminal tube cylindrical to urceolate (= urn-shaped), margin entire, lobed or tipped with 6–10(–13) appendages, anthers 6–16, within throat of staminal tube; *disc free*, tubular though sometimes short or even subannular, margin sometimes lobed; ovary 2–6-locular, each locule with 1 or 2 ovules, stylehead capitate to discoid. **Fruits** *capsular*, 2–6-valved, each valve with 1 or 2 seeds. **Seeds** anatropous, very variable, usually with aril or sarcotesta; embryo with thick, collateral, oblique or superposed cotyledons; radicle superior or adaxial, extending to the surface or included. Germination cryptocotylar or less frequently phanerocotylar; eophylls usually opposite, rarely spirally arranged, simple, trifoliate, or pinnate, entire or toothed.

Distribution. About 80 species of tropical E Asia from India and Sri Lanka (3) to S China, Indo-China, throughout Malesia (including Christmas Island, 1) to the Pacific south to Australia (15), New Caledonia (9), Norfolk Island (1), Lord Howe Island (1, endemic), New Zealand (1, endemic) and east to Niue (1). In Sabah and Sarawak, 22 (including one incompletely known) species are recognised. The greatest distribution of any Indo-Pacific genus in the family with high levels of endemism in New Guinea (16 of 28; *cf.* Borneo with 2 of 22, Peninsular Malaysia with 2 of 17, Fiji with 7 of 9 and New Caledonia with 8 of 9), demonstrating a distinctly austral richness by comparison with its ally *Chisocheton* and the largest genus in Borneo, *Aglaiia*.

Ecology. Various types of humid rain forest at 0–2580 m altitude with one rheophyte, *D. angustifolium* King, of Peninsular Malaysia.

Uses. The timber of several species of *Dysoxylum* in Sabah and Sarawak (e.g., *D. acutangulum* subsp. *acutangulum*, *D. alliaceum*, *D. arborescens*, *D. carolinae*, *D. cauliflorum*, *D. crassum*, *D. cyrtobotryum*, *D. densiflorum*, *D. excelsum*, *D. flavescens*, *D. grande*, *D. macrocarpum*, *D. mollissimum*, *D. oppositifolium*, *D. parasiticum* and *D. rigidum*) is suitable for medium to heavy construction work, planking, flooring, panelling, and for manufacturing high grade furniture, wood-pallets, veneer and plywood. (For details, cf. PROSEA 5, 3 (1998) 197 and Wong, T.M. (revised by S.C. Lim & R.C.K. Chung, 2002). A Dictionary of Malaysian Timbers, 2nd ed., Mal. For. Rec. No. 30: 46 & 65.)

Notes. *Dysoxylum* differs from *Chisocheton* in its anatropous seeds, though otherwise there are great similarities in those species of *Chisocheton* with a prominent disc and no pseudogemma, notably *C. macranthus* and allies, where there are fruits with stinging hairs similar to those in *D. sessile* Miq. of Maluku for instance. The genus is divisible into two sections, sect. **Cyrtochiton** and sect. **Dysoxylum** which can be distinguished as follows:

Sect. **Cyrtochiton:** Apical buds composed of stiletto- or spike-like young leaves. Inflorescences usually spicate (= unbranched). Flowers 4-merous. Seeds unitegmic. Species occurring in Sabah and Sarawak are: 1. *D. acutangulum*, 4. *D. brachybotrys*, 5. *D. carolinae*, 8. *D. cyrtobotryum*, 11. *D. flavescens*, 12. *D. grande*, 13. *D. macrocarpum*, 16. *D. oppositifolium*, 17. *D. pachyrhache*, 21. *D. rugulosum* and 22. *Dysoxylum* sp. 3.

Sect. **Dysoxylum:** Apical buds composed of fist-like young leaves. Inflorescences usually branched. Flowers (3 or) 4–6-merous. Seeds bitegmic. Species known in Sabah and Sarawak are: 2. *D. alliaceum*, 3. *D. arborescens*, 6. *D. cauliflorum*, 7. *D. crassum*, 9. *D. densiflorum*, 10. *D. excelsum*, 14. *D. magnificum*, 15. *D. mollissimum*, 18. *D. papillosum*, 19. *D. parasiticum* and 20. *D. rigidum*.

Key to *Dysoxylum* species (excluding species 22 [*Dysoxylum* sp. 3])

1. Leaves opposite or subopposite or subdecussate.....2
Leaves in spirals.....4
2. Leaflets pubescent, at least on the lower surface.....16. **D. oppositifolium**
Leaflets glabrous.....3
3. Apical buds stiletto-like. Leaves subdecussate. Leaflets subopposite; blades elliptical, 9–15 × 5–6.5 cm; lateral veins 14–16 on each side of midrib; lateral and intercostal veins obscure.....1. **D. acutangulum**
Apical buds spike-like. Leaves opposite or subopposite. Leaflets opposite; blades

- oblong, 7(–12) × 3(–4) cm; lateral veins *c.* 20 on each side of midrib; lateral and intercostal veins prominent.....**5. *D. carolinae***
4. Terminal leaflet present.....5
Terminal leaflet absent; small ‘spike’ or scar almost always present.....9
5. Inflorescences axillary.....6
Inflorescences on branches or bole.....7
6. Twigs 3–5 mm diameter apically. Leaves with up to 4 leaflets on each side of rachis; blades elliptical to obovate, apex conspicuously acuminate. Inflorescences 2–8(–25) cm long. Petals 5. Anthers 10 (or 11). Fruits usually 5-valved.....**3. *D. arborescens***
Twigs *c.* 10 mm diameter apically. Leaves with up to 14(–17) leaflets on each side of rachis; blades oblong to ovate, apex apiculate to acute. Inflorescences to 60 cm long. Petals 4. Anthers 8. Fruits usually 4-valved.....**15. *D. mollissimum***
7. Calyx 7–15 mm tall.....**19. *D. parasiticum***
Calyx less than 4 mm tall.....8
8. Twigs with prominent petiole scars. Leaves to 150 cm long, with up to 8 strongly asymmetrical lateral leaflets on each side of rachis. Inflorescences racemose or thyrsoid, on branches. Fruits silky hairy.....**9. *D. densiflorum***
Twigs lenticellate. Leaves to 60 cm long, with 3–6 not strongly asymmetrical leaflets on each side of rachis. Inflorescences spicate, on branches and bole. Fruits more or less glabrous.....**6. *D. cauliflorum***
9. Apical bud not spike-like, the young leaves like clenched fists.....10
Apical bud spike-like or stiletto-shaped.....15
10. Leaves strictly paripinnate with terminal pair of leaflets.....**7. *D. crassum***
Leaves different.....11
11. Leaflets glabrous; intercostal venation markedly scalariform. Petals 5. Tissues onion-scented.....**20. *D. rigidum***
Leaflets glabrous or not; intercostal venation different. Petals 4 or 5. Tissues onion-scented or not.....12
12. Lower surface of leaflets densely reddish-velutinous or yellowish-pilose. Inflorescences spicate.....13
Leaflets and inflorescences different.....14
13. Shoots and lower surface of leaflets densely reddish-velutinous. Leaves to 100 cm long; leaflets 5 or 6 on each side of rachis; blades oblong. Inflorescences to 60 cm long. Calyx 5-crenate. Petals 5. Anthers 10. Fruits depressed globose, at least 8 cm diameter.....**14. *D. magnificum***
Shoots and lower surface of leaflets yellowish-pilose. Leaves to 45 cm long; leaflets 2 or 3 on each side of rachis; blades elliptical to obovate. Inflorescences 1.5–7.5 cm long. Calyx 4-toothed. Petals 4. Anthers 8. Fruits pear-shaped, *c.* 2 cm diameter.....**18. *D. papillosum***

14. Leaflets asymmetrical at base, rarely subequal, shining above. Calyx and corolla glabrous. Infructescences more or less branched. Whole plant, or at least fruit, onion-scented.....**2. D. alliaceum**
 Leaflets more or less symmetrical, not markedly shining above. Calyx and corolla pubescent. Infructescences more or less unbranched. Whole plant not smelling of onions.....**10. D. excelsum**
15. Lower surface of leaflets yellow-tomentose.....16
 Lower surface of leaflets glabrous to subglabrous.....17
16. Leaves with 6–9 leaflets on each side of rachis; lateral veins of leaflets 23–25 on each side of midrib. Inflorescences 10–30 cm long. Fruits depressed globose..**12. D. grande**
 Leaves with 2–4 leaflets on each side of rachis; lateral veins of leaflets 15–18 on each side of midrib. Inflorescences to 8 cm long. Fruits subpyriform..**17. D. pachyrhache**
17. Intercoastal venation scarcely distinguishable from lateral veins.....**1. D. flavescens**
 Lateral veins distinct; intercoastal venation often obscure.....18
18. Leaves strictly paripinnate.....19
 Leaves more or less imparipinnate with almost alternate leaflets.....20
19. Petioles 6–15 cm long. Lateral veins of leaflets prominent below. Inflorescences supra-axillary. Petals *c.* 8 mm long. Staminal tube crenate to toothed.....**21. D. rugulosum**
 Petioles 4–7 cm long. Lateral veins of leaflets subprominent below. Inflorescences in the axils of leaves or petiole scars. Petals *c.* 6 mm long. Staminal tube truncate.....**4. D. brachybotrys**
20. Twigs 7–13 mm diameter apically. Apical buds spike-like. Leaflet blades elliptical-ovate, to 30 × 10 cm; lateral veins 13–18 on each side of midrib. Inflorescences with spreading branches. Fruits to 10 cm diameter.....**13. D. macrocarpum**
 Twigs 5–7 mm diameter apically. Apical buds stiletto-like. Leaflet blades oblong-ovate, 18–23 × 6–12 cm; lateral veins 7–13 on each side of midrib. Inflorescences subspicate to scarcely branched. Fruits *c.* 5 cm diameter.....
**8. D. cyrtobotryum**

1. *Dysoxylum acutangulum* Miq.

(Latin, *acutangulus* = acute-angled; referring to the petiole)

Sect. *Cyrtochiton*

Fl. Ind. Bat., Suppl. (1861) 196, 503; King *op. cit.* 41; Ridley *op. cit.* (1922) 393; Anderson *op. cit.* (1980) 251; Mabberley *op. cit.* (1989) 240, *op. cit.* (1994) 303; Mabberley *et al. op. cit.* 129; Turner, Gard. Bull. Sing. 47 (1995) 340; Argent *et al.* (eds.) *op. cit.* 419; PROSEA 5, 3 (1998) 200; Beaman & Anderson *op. cit.* 129. **Type:** *Teijsmann s.n. [HB 3218]*, Sumatra, Banka, near Jibus (holotype U [Acc. No. 39415]; isotypes BO, K L [Acc. No. 9032951]). **Synonym:** *Alliaria acutangula* (Miq.) Kuntze *op. cit.* 109.

Distribution. A widespread but locally uncommon species distributed from Peninsular Thailand, throughout Malesia, to tropical Australia and the Solomon Islands.

Notes. Two subspecies, subsp. *acutangulum* and subsp. *foveolatum* (Radlk.) Mabb. are recognised with the latter differing from the former in being a smaller tree with leaflets 4–6 (or 7) on each side of rachis (vs. 2–4), narrowly elliptical (vs. elliptical), usually with domatia (vs. without domatia), and is not found in Borneo.

subsp. **acutangulum**

Tree to 47 m tall; bole to 140 cm diameter, fluted and clear to 18 m tall; buttresses to 3 m tall and 2 m out. **Bark** smooth, yellowish, with conspicuous lenticels, becoming irregularly cracked and shedding large scales; inner bark yellowish to bright orange, somewhat speckled and with groups of conspicuously thickened lenticels. **Sapwood** orange-brown, hard. **Twigs** c. 6 mm diameter apically, with conspicuous petiole scars and lenticels. **Apical buds** *stiletto-like* with minute fulvous-tomentum. **Leaves** *subdecussate*, 15–30(–40) cm long, *paripinnate* with minute apical spike or its scar; petioles 8–11 cm long, 3–4 mm diameter, grooved and angled adaxially when dry, base somewhat swollen; *leaflets* *glabrous* to minutely puberulous, 2–4 on each side of rachis, *subopposite*; *blades* of largest leaflets (the most distal) *elliptical*, 9–15 × 5–6.5 cm, coriaceous, when fresh minutely pellucid-punctate, minutely rugulose when dry, base acute, more or less asymmetrical, apex acute to acuminate; *lateral veins* 14–16 on each side of midrib, rather *obscure*, spreading, without domatia in their axils; petiolules 5–8(–10) mm long, scarcely swollen. **Inflorescences** *spicate*, 3–8 cm long, narrow, axillary to borne on twigs; axes pubescent, bearing fascicles of 1–few flowers; bracts c. 0.5 mm long, densely pubescent. **Flowers** sweetly scented; pedicels to 1 mm long; *calyx* c. 2.5 mm diameter, very shallowly crateriform (= bowl-shaped), confluent with pseudopedicel c. 1 mm long, sparsely shortly pubescent outside, *margin somewhat 4-lobed*; *petals* 4, oblong, 12–13 mm long, more or less puberulous on both sides, yellow or creamy-yellow, apices acute; staminal tube sometimes sparsely pubescent outside, glabrous inside, margin crenulate, *anthers* 8 (or 10), ovate to elliptical, c. 1 mm long, weakly exerted; disc shallowly cup-shaped, c. 1.5 mm tall, fleshy, glabrous or sometimes pubescent inside, red; ovary densely pubescent, (3 or) 4-*locular*, each locule with 2 collateral ovules, style pubescent in proximal half, stylehead subdiscoid. **Fruits** subglobose to pyriform (= pear-shaped), 5–8 cm diameter, (3 or) 4-valved, glabrous, orange; pericarp to 1 cm thick, heavily veined when old, latex white. **Seeds** (3 or) 4, sometimes some aborted, ellipsoid, c. 2 cm long, black with small orange ariloid hilum on one side.

Distribution. ?Peninsular Thailand, Sumatra (including Riau-Lingga Archipelago, Billiton, Banka), Peninsular Malaysia, Borneo (Sabah, Sarawak and Kalimantan) and the Philippines (Palawan). In Sabah, known from Ranau and Tawau districts (e.g., *SAN* 26459, *SAN* 30761, *SAN* 53882 and *SAN* 94226) and in Sarawak from Lawas district (e.g., *S* 27922). Also occurring in E Kalimantan (e.g., *Sabana* 2).

Ecology. Rain forest at altitudes to 1000 m.

Uses. *Dysoxylum acutangulum* subsp. *acutangulum* is perhaps traditionally the most important native Meliaceous timber tree in the region and was formerly much exported from Sumatra (Banka) to Java. The wood of the bole, and particularly the buttresses, is beautifully marked but difficult to work (Burkill, DEPMP 1 (1935) 884 and PROSEA 5, 3 (1998) 197): it has been largely used for furniture but also beams, cartwheels and coffins.

2. *Dysoxylum alliaceum* (Blume) Blume

Fig. 19.

(Latin, *alliaceus* = onion-like; referring to the smell of the tissues when bruised)**Sect. *Dysoxylum***

Bijdr. Fl. Ned. Ind. (1825) 172; Backer & Bakhuizen *f. op. cit.* 123; Anderson *op. cit.* (1980) 251; Mabberley *op. cit.* (1989) 240; Kessler & Sidiyasa, TBSK-EK (1994) 169; Mabberley *et al. op. cit.* 106; Turner *op. cit.* 340; Coode *et al. (eds.) op. cit.* 204; Argent *et al. (eds.) op. cit.* 419; PROSEA 5, 3 (1998) 200; Beaman & Anderson *op. cit.* 129. **Basionym:** *Guarea alliacea* Blume *apud* Nees, Flora 7 (1824) 290. **Type:** Blume '196', Java, G. Salak (holotype L [Acc. No. 903257765]; isotypes L [Acc. No. 903257762 & 90325776]). **Synonyms:** *Prasoxylon alliaceum* (Blume) M.J.Roem. *op. cit.* 101, *nom. superfl.*; *Dysoxylum lampongum* Miq. *op. cit.* (1861) 196, 503, Merrill *op. cit.* (1921) 320, Masamune *op. cit.* 376; *Dysoxylum thyrsoides* Hiern *op. cit.* 547, Merrill *op. cit.* (1921) 320, Ridley *op. cit.* (1922) 393, Masamune *op. cit.* 376, Anderson *op. cit.* (1980) 252. (For complete synonymy, cf. Mabberley *et al. op. cit.*)

Tree to 38 m tall, often of poor form; bole to 80 cm diameter, fluted to *c.* 4 m with buttresses to 60 cm tall and 1 m out. **Bark** thin, lenticellate to finely fissured and shedding irregular strips; inner bark red-brown, yellower inside, *usually with strong smell of onions*. **Sapwood** fawnish; heartwood red-brown. **Twigs** with conspicuous petiole scars, striate, non-lenticellate, 5–8 mm diameter apically. **Apical buds** with *fist-shaped* young leaves, more or less pubescent. **Leaves** spirally arranged, to 60(–120) cm long, *more or less paripinnate, usually smelling of onions when crushed*; petioles 5–15 cm long, flattened adaxially, weakly swollen at base; *leaflets subglabrous*, subcoriaceous, 3–6(–8) on each side of rachis, opposite to subopposite, *with an apical pair or one of these appearing terminal and with a small apical scar*; blades elliptical or ovate, or subfalcate, 7.5–25 × 2.5–7.5 cm, *shiny dark green above, base more or less asymmetrical*, apex acuminate; lateral veins 8–12(–14) on each side of midrib, arcuate, subprominent below; petiolules 5–20 mm long, sulcate. **Inflorescences** to 40 cm long, *pyramidal; proximal branches 8–20 cm long with branchlets to 5 cm long*, bearing cymes of 1–3 flowers; axes puberulous; bracts and bracteoles minute. **Flower** sweetly scented; buds oblong with truncate apex; pedicels 2.5–4 mm long; *calyx* shallowly cup-shaped or salver-shaped, 2.5–3 mm diameter, *glabrous* to subpuberulous outside, *margin 4-toothed*; *petals 4 or 5*, linear, 5–8 mm long, *valvate, glabrous* or pubescent inside, white, or pinkish, drying black; staminal tube glabrous or puberulous outside, more or less hairy inside, margin subtruncate to 8(–10)-denticulate, *anthers 8 (or 10), c. 1 mm long, included*; disc *c. 1 mm tall*, more or less pubescent on both sides, truncate to obscurely lobed, margin ciliate; *ovary* glabrous to hirsute, *3-locular*, each locule with 2 ovules, style terete, stylehead subdiscoid, somewhat dimpled. **Infructescences** *more or less branched*, to 25 cm long. **Fruits** to 7.5 cm diameter, subglobose or lobed and constricted between seeds or beaked, occasionally markedly so (the beak to 15 mm long) when 1-seeded, greenish white when unripe, red at maturity, drying black. **Seeds** 1–4 per fruit, oblong-globose; testa (= seed coat) red, non-arillate, when cut producing white latex and (usually) *strong smell of onions*.

Vernacular names. Sabah—*langsats-langsats* (Malay), *lantupak* (Malay), *polong longom* (Dusun Kinabatangan). Sarawak—*kayu tunying* (Punan), *segera* (Iban).

Distribution. Andaman Islands and Peninsular Thailand, throughout Malesia to the Solomon Islands and Queensland. In Borneo, known in Sabah from Beaufort, Keningau, Kinabatangan, Kota Belud, Labuk Sugut, Lahad Datu, Papar, Ranau, Sandakan, Sipitang and Tawau districts (e.g., Mabberley 1705, SAN 21470, SAN 29811, SAN 36280 and SAN

99296) and in Sarawak from Bintulu, Limbang, Lubok Antu, Lundu and Miri districts (e.g., *S* 33919, *S* 38056, *S* 39496, *S* 40316 and *S* 43137). Also occurring in Brunei (e.g., *SAN* 17493) and Kalimantan (e.g., *Burley et al.* 831 and *Wilkie* 93414).

Ecology. Rain forest, including that on limestone, at altitudes to 1800 m. A similar onion scent of the slashed barks/trees is also found in *Dysoxylum magnificum*, *D. mollissimum* and *D. rigidum*. That it is not universal in *D. alliaceum* deserves study.

Notes. Although rather uniform in Borneo, this is a polymorphic species across its range yet it cannot be readily subdivided formally. It is closely related to *Dysoxylum excelsum*; sterile dried material of the two species sometimes being particularly difficult to separate. Large-flowered forms of *D. alliaceum* approach the small-flowered forms of *D. excelsum*, though the latter never have the onion smell, but have larger bracts and bracteoles and, generally, smaller infructescences, than does *D. alliaceum*.

3. *Dysoxylum arborescens* (Blume) Miq.

(Latin, *arborescens* = tree-like)

Sect. *Dysoxylum*

Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 24; King *op. cit.* 38; Merrill *op. cit.* (1921) 320; Ridley *op. cit.* (1922) 391; Masamune *op. cit.* 375; Backer & Bakhuizen *f. op. cit.* 123; Anderson *op. cit.* (1980) 252; Mabberley *op. cit.* (1989) 242; Whitmore, Tantra & Sutisna *op. cit.* 231; Mabberley *et al. op. cit.* 103; Turner *op. cit.* 341; PROSEA 5, 3 (1998) 200; Beaman & Anderson *op. cit.* 129. **Basionym:** *Goniocheton arborescens* Blume *op. cit.* (1825) 177. **Type:** Blume *s.n.* [‘905’], Java, foot of G. ‘Salak et Seribu’, 1824 (holotype L [Acc. No. 90329565]; isotype L [Acc. No. 90329566]). **Synonyms:** *Trichilia arborescens* (Blume) Spreng., Syst. Veg. 4, 2 (1827) 252; *Alliaria arborescens* (Blume) Kuntze *op. cit.* 109; *Dysoxylum rubrum* Merr., Philip. Govt. Lab. Bur. Bull. 35 (1906) 32, Anderson *op. cit.* (1980) 252.

Treelet or tree to 20(–30) m tall, but usually less and often flowering when *c.* 1 m or so high; bole to 45 cm diameter, fluted or with buttresses to 1 m tall and 45 cm out. **Bark** smooth to weakly cracked, lenticellate, grey-brown to blackish, sometimes mottled; inner bark straw to pale brown. **Sapwood** fawnish. **Twigs** slender, 3–5 mm diameter apically, rough with prominent lenticels, grey-brown. **Apical buds** with fist-shaped young leaves. **Leaves** spirally arranged, to 45 cm long, *imparipinnate*, though some leaves *paripinnate* also; petioles to 7 cm long, subterete to weakly angled, glabrous, base swollen, drying blackish; leaflets chartaceous to subcoriaceous, glabrous; *lateral leaflets to 4 on each side of rachis; blades elliptical*, sometimes narrowly so, *to obovate*, 8.5–18 × 3–7 cm, most proximal the smallest, base cuneate, sometimes more or less asymmetrical, *apex conspicuously acuminate*, acumen to 12 mm long; lateral veins 7–9(–10) on each side of midrib, spreading, arcuate; petiolules to 6 mm long, swollen, drying blackish. **Inflorescences** *subaxillary*, 2–8(–25) cm long, tawny-puberulous; *branches somewhat congested, subascending or subsquarrose*, to 5(–12) cm long. **Flowers** sweetly scented; bracteoles triangular, to 1.5 mm, tawny pubescent, fugacious (= ephemeral); *calyx* shallowly cup-shaped, 2.5–4 mm diameter distally, articulated with pedicel by slender pseudopedicel 3–6 mm long, somewhat appressed fawny-pubescent, *margin irregularly 5-lobed*; corolla weakly clavate in bud, adhering to staminal tube at base, *petals (4 or) 5 (or 6)*, 7–10 × 1.8–2.2 mm, valvate, waxy,

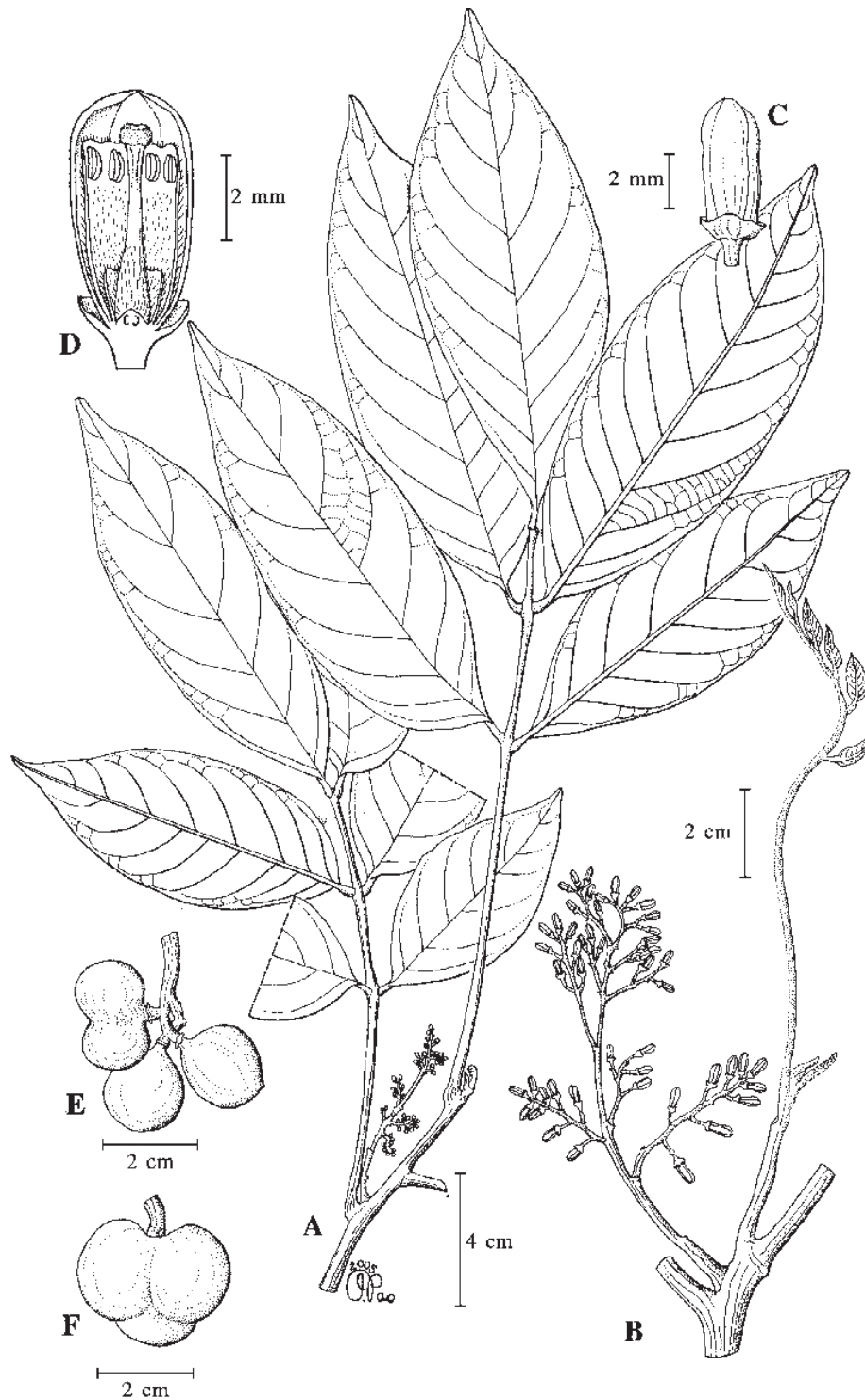


Fig. 19. *Dysoxylum alliaceum*. A, flowering leafy twig; B, male inflorescence; C, male flower bud; D, longitudinal section of male flower bud; E, infructescence; F, fruit. (A from SAN A 4034, B–D from SAN A 2578, E from SAN 44502, F from SAN A 4808.)

creamy-green to off white, glabrous or sometimes with minute hairs outside, apex boat-shaped; staminal tube sparsely appressed pubescent inside, glabrous outside, margin subtruncate to weakly crenulate, *anthers* 10 (or 11), c. 1 mm long, inserted near margin; disc shortly tubular, 1–1.5 mm tall, ascendant pubescent inside, glabrous outside, margin crenulate; *ovary* pubescent, (3 or)4- or 5-locular, each locule with 2 collateral ovules, style terete, ascendant-pubescent in proximal 2/3, stylehead subdiscoid, often dimpled, c. 1 mm diameter. **Infructescences** to at least 25 cm long, sometimes appearing terminal, suberect; axes c. 5 mm diameter, subterete. **Fruits** depressed globose, to 3 cm diameter, (*rarely* 3)5-valved, often somewhat irregular and weakly angled between valves, bright pink-red, drying black, glabrous; endocarp white within. **Seeds** 1–6, c. 18 × 15 mm, planoconvex, non-arillate; testa bright orange, sarcotestal; hilum c. 8 mm diameter, white.

Vernacular names. Sabah—*kalimangang* (Ranau), *olop-olop* (preferred name), *tama malid* (Malay, Tambunan).

Distribution. Nicobar and Andaman Islands, Taiwan (Lan Yü), throughout Malesia to Solomon Islands, Queensland and Vanuatu. In Borneo, recorded in Sabah from Kinabatangan, Kota Belud, Kota Marudu, Lahad Datu, Papar, Ranau, Sandakan, Tambunan and Tenom districts (e.g., *Pennington* 7932, *SAN* 15317, *SAN* 27269, *SAN* 89310 and *SAN* 109760) and in Sarawak from Bau, Kuching, Limbang, Lundu and Serian districts (e.g., *S* 5769, *S* 28101, *S* 37402 and *S* 76648). Also occurring in Kalimantan (e.g., *Endert* 1716 and *Kostermans* 5756). Not yet recorded from Brunei.

Ecology. A very common tree of various forest types including that on limestone, at altitudes to 1500 m, also persisting in village orchards and edges of forest.

Notes. Most of the specimens I have examined have bisexual flowers. Specimens from Borneo (and New Guinea) often have fasciated proliferating inflorescences, though none with mature flowers has been seen. Similar conditions are known in *Dysoxylum cyrtobotryum* (q.v.).

4. *Dysoxylum brachybotrys* Merr.

(Greek, *brachy*- = short, *-botrys* = bunch (of grapes); referring to the inflorescence)

Sect. *Cyrtochiton*

Phil. J. Sci. 26 (1925) 461; Mabblerley *et al. op. cit.* 128; Coode *et al. (eds.) op. cit.* 204; Beaman & Anderson, *op. cit.* 130. **Type:** *BS* 37012, the Philippines, Mindanao, Zamboanga, Malangas (holotype PNH†; isotypes A, K, L, P, US). **Synonym:** *Dysoxylum brachystachys* Ridl., Bull. Misc. Inform. Kew (1930) 364.

Tree to 20 m tall, flowering when only a few metres tall; bole to 15 cm diameter. **Bark** rugulose; inner bark bright orange. **Sapwood** straw. **Twigs** c. 5 mm diameter apically. **Apical buds** *stiletto-like*, puberulent. **Leaves** *spirally arranged*, 20–30 cm long, *strictly paripinnate*, with *apical pair of leaflets and spike to 8 mm long or its scar between them*; *petioles* 4–7 cm long, swollen at base; *leaflets* 2–4 on each side of rachis, alternate to subopposite, chartaceous to subcoriaceous, *glabrous*, surface minutely verruculose when dry, paler below; blades oblong to narrowly elliptical or ovate, 8–18 × 3–7 cm, base acute, attenuate, apex cuspidate-acuminate acumen to 2 cm long; midrib prominent on both sides; *lateral veins* 7–9 on each side of midrib, some at least opposite, arcuate, *subprominent*

below, obscurely looped at extreme margin, domatia in axils of most; *intercostal venation obscure*; petiolules 5–8 mm long, rather swollen, especially apical ones, drying blackish. **Inflorescences** spicate, to 5 cm long, *in axils of leaves or petiole scars*; axes 2–3 mm diameter, puberulous, bearing congested cymules of subsessile flowers (*n.v.*); *calyx* cup-shaped, puberulous outside, yellowish, *margin 4-lobed*; *petals* 4, *c.* 6 × 2.5 mm, subpuberulous outside, cream; *staminal tube* glabrous, *truncate*, *anthers* 8, *c.* 1 mm long; disc *c.* 1 mm tall; ovary puberulous, style subpuberulous, stylehead orbicular. **Fruits** solitary, pyriform, *c.* 3.5 cm long and diameter, deeply 3- or 4-lobed, glabrous, veined, bright red when mature, drying black. **Seeds** 3 or 4, flattened ellipsoid, *c.* 2 × 1.5 cm, green; hilum *c.* 1 cm long.

Vernacular names. Sarawak—*bunyau* (Iban), *segera* (Iban).

Distribution. Borneo and the Philippines (Mindanao). In Borneo, known only in Sarawak from Bintulu, Kapit, Kuching, Lawas, Limbang, Lundu, Miri and Tatau districts (e.g., *Mabberley 1597*, *Pennington 7975*, *S 35174*, *S 41800* and *S 53827*) and in Brunei (e.g., *Dransfield JD 7164*).

Ecology. Rain forest to mossy forest at altitudes to 1200 m, common on ridges as at G. Lundu, Sarawak.

Notes. Several specimens have marked perforations, usually running along veins of expanded leaves, due to (?) insects. The domatia are characteristic, but the species is very closely related to *Dysoxylum rugulosum*.

5. *Dysoxylum carolinae* Mabb.

(Caroline M. Pannell (1955–), English botanist, monographer of *Aglaia*)

Sect. *Cyrtochiton*

Blumea 38 (1994) 305; *Mabberley et al. op. cit.* 131; *Turner op. cit.* 341; *Coode et al. (eds.) op. cit.* 204; *PROSEA* 5, 3 (1998) 200. **Type:** *Symington FD 49827*, Peninsular Malaysia, Pahang, Kemasul FR (holotype KEP [seen 1994, not found 2003]). **Synonym:** *Dysoxylum* sp. I, *Mabberley op. cit.* (1989) 246.

Tree to 45 m tall; bole to 110 cm diameter, fluted; buttresses to 4 m tall and 3 m out, 15 cm wide, concave. **Bark** smooth with large oblong lenticels to 6 mm long, to flaking, grey to dark brown; inner bark white with coarse orange flecks and strong smell of stewing vegetables. **Sapwood** yellow-brown. All young parts fulvous-tomentellous. **Twigs** 4–8 mm diameter apically, angled, greyish, held erect. **Apical buds** *spike-like*, plump. **Leaves** *opposite or subopposite*, 10–25 cm long, paripinnate, with small apical scar; petioles 5–8 cm long; *leaflets* 3–5 on each side of rachis, *opposite*, coriaceous, *upper surface* shining and *glabrous*, lower surface minutely rugulose; *blades oblong*, (subapical the largest) to 7(–12) × 3(–4) cm, base rounded to weakly oblique, apex acuminate; midrib sericeous, pale below, with domatia, strongly keeled above when fresh; *lateral veins c. 20 on each side midrib*, *prominent*, looped at margin; intercostal veins not distinct from lateral veins. **Inflorescences** (not yet collected in Borneo) to 10 cm long, *weakly branched*. **Flowers** faintly citronella-scented; *calyx c.* 5 mm diameter, *c.* 1.5 mm tall, *margin 4-lobed*; *petals* 4, *c.* 6 mm long, puberulous outside; staminal tube narrowed at apex, puberulous outside, becoming yellow,

anthers 8, ovate, c. 0.8 mm long, weakly exserted; disc shallowly cup-shaped, c. 1 mm high, yellow, margin truncate; *ovary* 4-locular, each locule with 1 ovule. **Infructescences** in axils of fallen leaves. **Fruits** depressed globose, to 6 × 8 cm, splitting into 4 valves, orange-red. **Seeds** 1 or 2 (or 3), c. 3 × 2.5 cm, black with orange sarcotesta.

Distribution. Vietnam (1 collection), Sumatra, Peninsular Malaysia, Singapore (extinct) and Borneo. In Borneo, recorded in Sabah from Keningau, Lahad Datu and Sandakan districts (e.g., *SAN 47101* and *SAN 40680*). Also known in Brunei (e.g., *Coode et al. 7113*) and Kalimantan (e.g., *Sidiyasa & Arifin 2105*). Not yet recorded from Sarawak.

Ecology. Lowland and hill forests at altitudes to 1100 m.

6. *Dysoxylum cauliflorum* Hiern

Fig. 20, Plates 5A & B.

(Latin, *cauliflorus* = bearing flowers on the trunk)

Sect. *Dysoxylum*

In Hooker f., Fl. Br. Ind. 1 (1875) 549; King *op. cit.* 45; Merrill *op. cit.* (1921) 320; Ridley *op. cit.* (1922) 396; Masamune *op. cit.* 375; Anderson *op. cit.* (1980) 252; Corner *op. cit.* 501; Mabberley *op. cit.* (1989) 242; Whitmore, Tantra & Sutisna *op. cit.* 231; Mabberley *et al. op. cit.* 86; Turner *op. cit.* 341; Coode *et al. (eds.) op. cit.* 204; PROSEA 5, 3 (1998) 200; Beaman & Anderson *op. cit.* 130. **Type:** *Maingay 1612* [= *Kew Distr. 327*], Peninsular Malaysia, 'Malacca', 1865-6 (holotype K; isotype L). **Synonyms:** *Dysoxylum beccarianum* C.DC. in A.P. de Candolle, Mon. Phan. 1 (1878) 495; Merrill *op. cit.* (1921) 320; *Alliaria beccariana* (C.DC.) Kuntze *op. cit.* 109; *Alliaria hiernii* Kuntze *op. cit.* 109; *Epicharis hierniana* Harms in Engler & Prantl, Nat. Pflanzenfam. ed. 2, 19b, 1 (1940) 168, t. 35K, *nom. superfl.*; *Lepisanthes forbesii* Baker f., J. Bot. London 62, Suppl. (1924) 25; *Dysoxylum foxworthyi* Elmer, Leaflet. Philip. Bot. 9 (1937) 3363.

Tree, 5–20(–30) m tall; clear bole to 16 m tall, to 50 cm diameter, sometimes fluted or with small buttresses to 60 cm tall, 5 cm wide and 30 cm out. **Bark** grey and smooth with lenticels and bosses of defunct inflorescences to mottled brown with rectangular flakes; inner bark fawn with sour smell and no conspicuous latex. **Sapwood** straw-coloured. **Twigs** 3–6 mm diameter apically, *lenticellate*. **Apical buds** with *fist-shaped young leaves*, more or less fulvous-pubescent. **Leaves** *spirally arranged, to 60 cm long, imparipinnate*; petioles 8–16 cm long, 4–5 mm diameter, terete to flattened or grooved adaxially when dry, more or less rusty puberulous or even tomentose, swollen at base; leaflets sparsely pubescent to densely rusty-tomentose, particularly on lower surface of veins and upper surface of midrib, papery when dry, rather bullate when fresh; *lateral leaflets 3–6 on each side of rachis*, opposite or subopposite; blades ovate-elliptical to ovate or obovate (terminal ones), to 17(–30) × 7 cm, the apical one the largest, base cuneate or acute, *lateral ones often asymmetrically so*; venation brochidodromous; lateral veins 9–12 on each side of midrib, prominent below; intercostal venation conspicuously reticulate; petiolules 4–9 mm long (to 15 mm on terminal leaflet), pubescent, somewhat swollen. **Inflorescences** *spicate*, to 8 cm long, *borne on persistent woody tubercles to 7 cm diameter on bole almost to ground level and major branches and sometimes axillary as well*, usually in fascicles, tawny-tomentose; bracts c. 1 mm long, triangular, appressed pubescent. **Flowers** sweetly scented; pedicels 2–3 mm long, pubescent; *calyx* cup-shaped 2–3 mm tall, *with 3 or 4 irregular shallow teeth*, appressed pubescent; *petals* (3 or) 4, linear-oblong, acute, 7–10 mm long, imbricate at least at apices, glabrous or sparsely hairy outside, white to pinkish or creamish; staminal tube

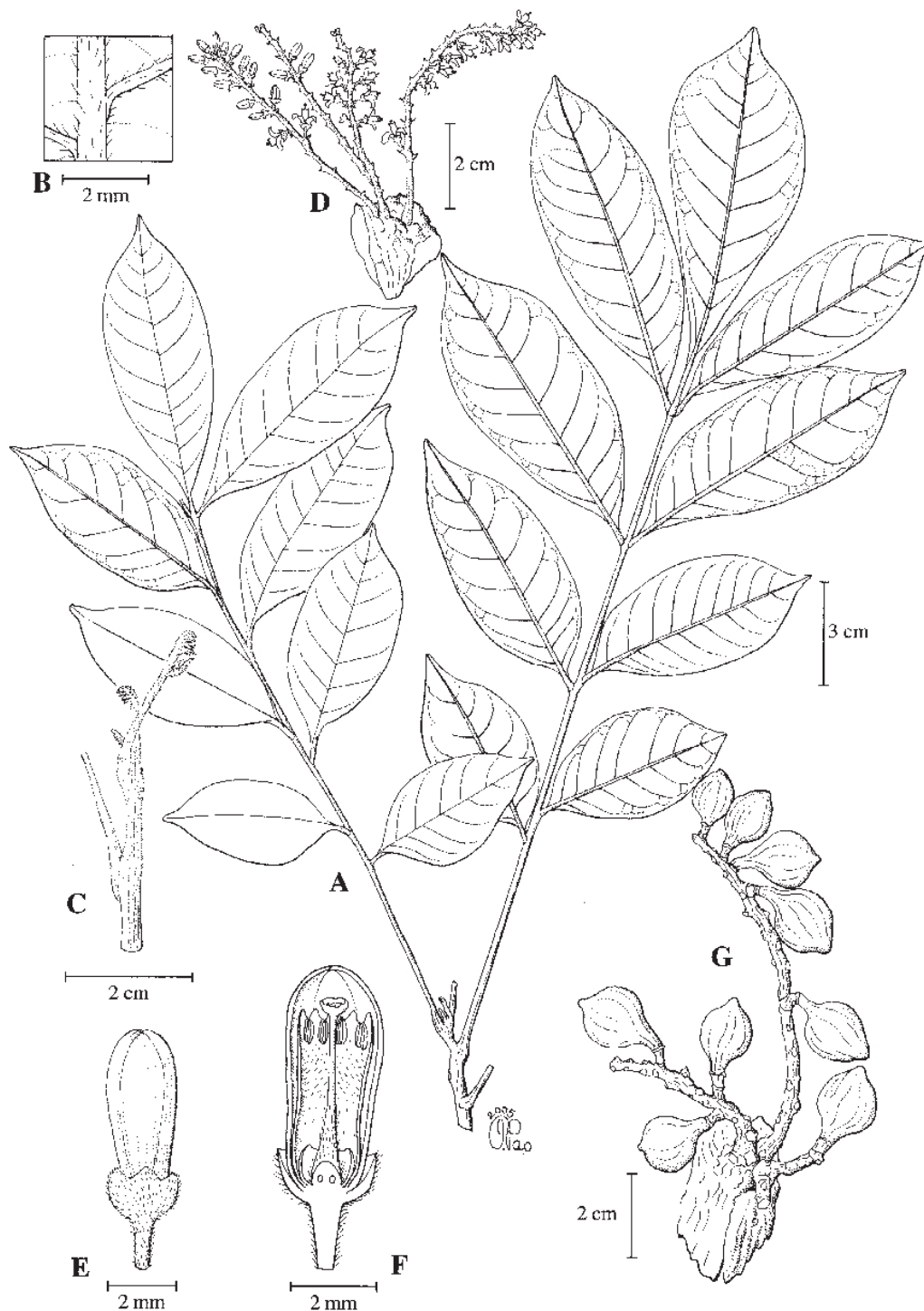


Fig. 20. *Dysoxylum cauliflorum*. A, leafy twig; B, detail of lower leaflet surface showing indumentum; C, distal part of young shoot showing developing young leaves; D, inflorescences; E, flower bud; F, longitudinal section of flower bud; G, infructescences. (A–B from *S* 54515, C from *S* 67556, D from *S* 24818, E–F from *SAN* 16866, G from *SAN* 87626.)

glabrous to puberulent outside, sericeous inside, white margin with (6 or) 8 bifid lobes, *anthers* (6 or) 8 at base of notches between lobes, ovate, *c.* 1 mm long; disc 3–4 mm long, glabrous, margin irregularly lobed; *ovary* (3 or) 4(or 5)-locular, pilose, style terete, pilose in proximal half, stylehead subdiscoid, yellow, **Fruits** solitary or clustered at end of rachis to 8 cm long, top-shaped, to 4 × 4 cm, 3- or 4(or 5)-locular, sometimes 3–4-angled or weakly-winged, *glabrous*, red; pericarp with milky latex; valves bright orange inside. **Seeds** 1–4, to 2 × 8 mm, planoconvex, borne on white placenta; aril basal, bright orange; testa black.

Vernacular names. Sabah—*golurut* (Brunei), *tapah* (Dusun Kinabatangan). Sarawak—*segera* (Iban), *uchong chit* (Iban).

Distribution. ?Myanmar, Indo-China (Vietnam, Cambodia), Thailand, Sumatra, Peninsular Malaysia, Borneo and the Philippines (Palawan). In Borneo, recorded in Sabah from Kinabatangan, Labuk Sugut, Lahad Datu, Ranau, Sandakan, Tawau and Tenom districts (e.g., *FRI* 41277, *Mabberley* 1692, *SAN* 73260, *SAN* 88688 and *SAN* 93289) and in Sarawak from Kapit, Kuching, Lawas, Limbang, Lundu, Miri and Samarahan districts (e.g., *Mabberley* 1576, *S* 24818, *S* 30420, *S* 42930 and *S* 52441). Also occurring in Brunei (e.g., *BRUN* 120, *BRUN* 3380 and *Kirkup* DK 618) and Kalimantan (e.g., *Burley et al.* 2567).

Ecology. Lowland, hill and lower montane rain forests at altitudes to 1500 m, including ridge forest, freshwater swamp forest and heath forest. A common tree in Borneo, where it is often the most conspicuous of all Meliaceae on account of its striking cauliflory.

7. *Dysoxylum crassum* Mabb.

Fig. 21.

(Latin, *crassus* = thick; referring to the floral parts)

Sect. *Dysoxylum*

Blumea 38 (1994) 305; *Mabberley et al. op. cit.* 98. **Type:** *Murthy* S 22671, Borneo, Sarawak, Marudi district, Dapoi, Long Nyalau (holotype FHO; isotypes BO, K, KEP, L, SAN, SAR, SING).

Tree to 30 m tall; bole to 45 cm diameter. **Bark** fawn to dark purplish brown, fissured to flaking; inner bark pinkish. **Twigs** 5–7 mm diameter apically, striate. **Apical buds with more or less fist-shaped pubescent young leaves.** Lateral buds supra-axillary, pale, pubescent, conspicuous. **Leaves** spirally arranged, 16–30 cm long, strictly *paripinnate*, with terminal spike or its stub; petioles 4–6 cm long, deeply sulcate to winged, rather warty; leaflets 3–5 on each side of rachis, coriaceous, glabrous; blades elliptical-oblong, 9–14 × 3.5–6 cm, base weakly asymmetrical, cuneate, apex acute to subacuminate; midrib sunken above, prominent below; lateral veins 6–9 on each side midrib, very obscure; petiolules 5–9 mm long, sulcate, blackish when dry. **Inflorescences** 2–4 cm long, *branched*, few-flowered, supra-axillary or borne on lateral dwarf shoots; axes stout, woody, fawn-pubescent; bracts triangular, *c.* 2 mm long, pubescent. **Flowers** sweetly scented; pedicels *c.* 3 mm long, articulated with pseudopedicels; *calyx* *c.* 4.5 × 8 mm, with pseudopedicel *c.* 1 mm long, more or less pubescent outside, *margin irregularly 5-lobed*; *petals* 5, lanceolate, *c.* 15 × 6 mm, papillose, pale green to creamy-white; staminal tube glabrous, margin minutely *c.* 20-lobed, the lobes truncate, *anthers* 10, ellipsoid, *c.* 1 mm long, more or less minutely hairy, weakly exerted; disc cushion-like, *c.* 1 mm tall, fleshy, glabrous; *ovary* glabrous, 5-locular, each locule with 2 collateral ovules, style terete, glabrous, stylehead depressed capitate,

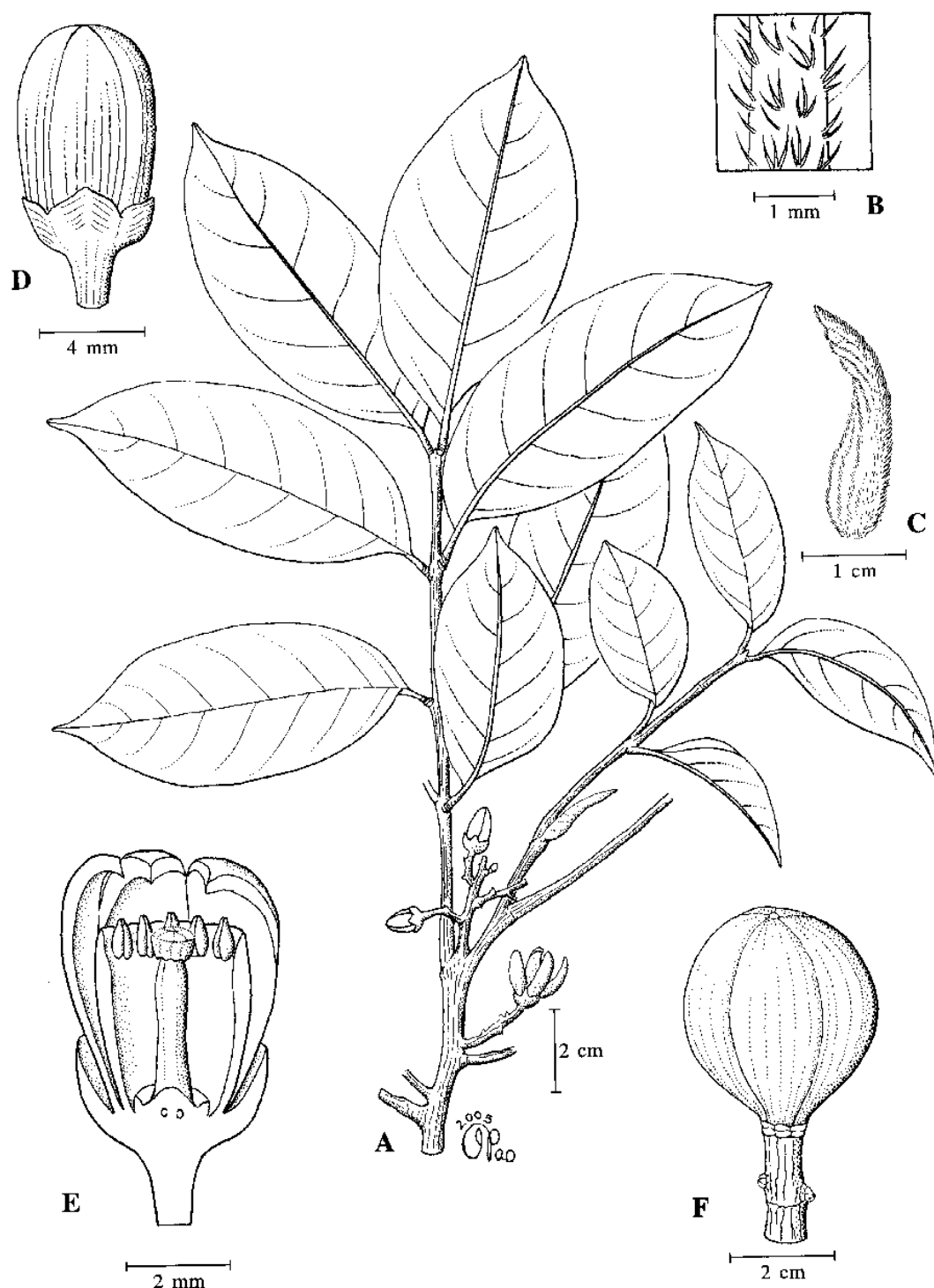


Fig. 21. *Dysoxylum crassum*. A, flowering leafy twig; B, detail of indumentum on lower surface of midrib; C, expanding apical bud; D, female flower bud; E, longitudinal section of female flower bud; F, fruit. (A from *S* 32877, B–C from *S* 22671, D–E from *S* 19970, F from *Nooteboom* 2115.)

apically dimpled. **Fruits** globose, at least 3 cm diameter, apically mamillate, weakly stipitate, 5-locular. **Seeds** unknown.

Distribution. Endemic in Borneo; known only in Sarawak from Kapit, Lawas and Marudi districts (e.g., *Nooteboom & Chai 2115*, *S 19970* and *S 32877*) and in Brunei (*Kirkup et al. 961*).

Ecology. Mixed dipterocarp and *kerangas* forest, at 700–1150 m altitude.

8. *Dysoxylum cyrtobotryum* Miq.

Fig. 22.

(Greek, *kurtos* = curve, *botrys* = bunch; with a curved bunch of fruits)

Sect. *Cyrtochiton*

Fl. Ind. Bat. Suppl. 1 (1861) 196, 504; Merrill *op. cit.* (1921) 320; Masamune *op. cit.* 375; Mabberley *op. cit.* (1989) 243; Whitmore, Tantra & Sutisna *op. cit.* 231; Mabberley *et al. op. cit.* 123; Turner *op. cit.* 341; Coode *et al.* (eds.) *op. cit.* 205; Argent *et al.* (eds.) *op. cit.* 419; PROSEA 5, 3 (1998) 200; Beaman & Anderson *op. cit.* 130. **Type:** *Teijsmann s.n.* [*HB 578*], Borneo, Sumatra, near Panti (holotype U [*Acc. No. 39403*]; isotype L [*Acc. No. 903295118*]). **Synonyms:** *Dysoxylum cyrtobotryum* var. *borneense* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 12; *Alliaria cyrtobotrya* (Miq.) Kuntze *op. cit.* 103; *Dysoxylum kinabaluense* Merr., Phil. J. Sci. Bot. 13 (1918) 75, *op. cit.* (1921) 320, *op. cit.* (1929) 120, Masamune, *op. cit.* 376.

Tree to 30 m tall, but often much less; bole to 60 cm diameter, sometimes fluted at base or with buttresses to 1 m tall, to 30 cm out. **Bark** pale brownish grey, smooth and lenticellate to scaling, brittle; inner bark pale yellowish brown, sometimes mottled. **Sapwood** pale yellow; heartwood red-brown with sour smell. **Twigs** angled and marked by distinct petiole scars, often dull purple-tinged when young, 5–7 mm diameter apically. **Apical buds** stiletto-like. **Leaves** spirally arranged, to 67 cm long, more or less imparipinnate with a scar next to the 'terminal' leaflet; petioles 15–22 cm, 3–5 mm diameter, flattened adaxially, glabrescent; leaflets subglabrous, sometimes sparsely hairy on venation below, coriaceous, subsessile, lateral leaflets 4 or 5 (or 6) on each side of rachis, almost alternate; blades oblong-ovate, sometimes narrowly so, 18–23 × 6–12 cm, base more or less asymmetrical, acute to subcuneate, apex acute-acuminate; lateral veins 7–13 on each side of midrib, distinct, squarrose at origin, looping but scarcely joining at margin, on drying sometimes yellowish; petiolules 0–5 mm long. **Inflorescences** 8–25 cm long, subspicate to scarcely branched, squarrose, axillary to ramiflorous; axes sparsely hairy; subsessile cymules 1–7-flowered; bracts c. 1 mm long, subtriangular. **Flowers** fragrant; bracteoles minute; calyx c. 4 mm tall, apically cup-shaped, basally a pseudopedicel, subpuberulent outside, olive-green, margin 4(or 5)-toothed, valvate; petals 4 (or 5), elliptical-oblong, 5–7 × 2 mm, valvate to apically imbricate, puberulent outside, yellowish, sometimes pinkish apically; staminal tube glabrous, off-white, weakly hairy outside, margin 8(–10)-toothed, anthers (6 or) 8 (or 10), elliptical-ovate, c. 1.5 mm long, yellow, more or less included; disc 1–1.5 mm tall, not exceeding ovary, glabrous, margin irregularly 8–12-toothed; ovary hairy, (2 or) 3-locular, each locule with 2 collateral ovules, style cylindrical, furrowed, hairy, pale green, stylehead subcapitate, with basal annulus, white to pale orange. **Fruits** globose to fig-shaped, c. 4 × 5 cm, often veiny or wrinkled, orange-red (black on drying); pericarp with white latex. **Seeds** 1–6, ellipsoid to suboblong, 25–35 mm long, 15–20 mm across, shiny brown-orange, (?) sarcotestal.

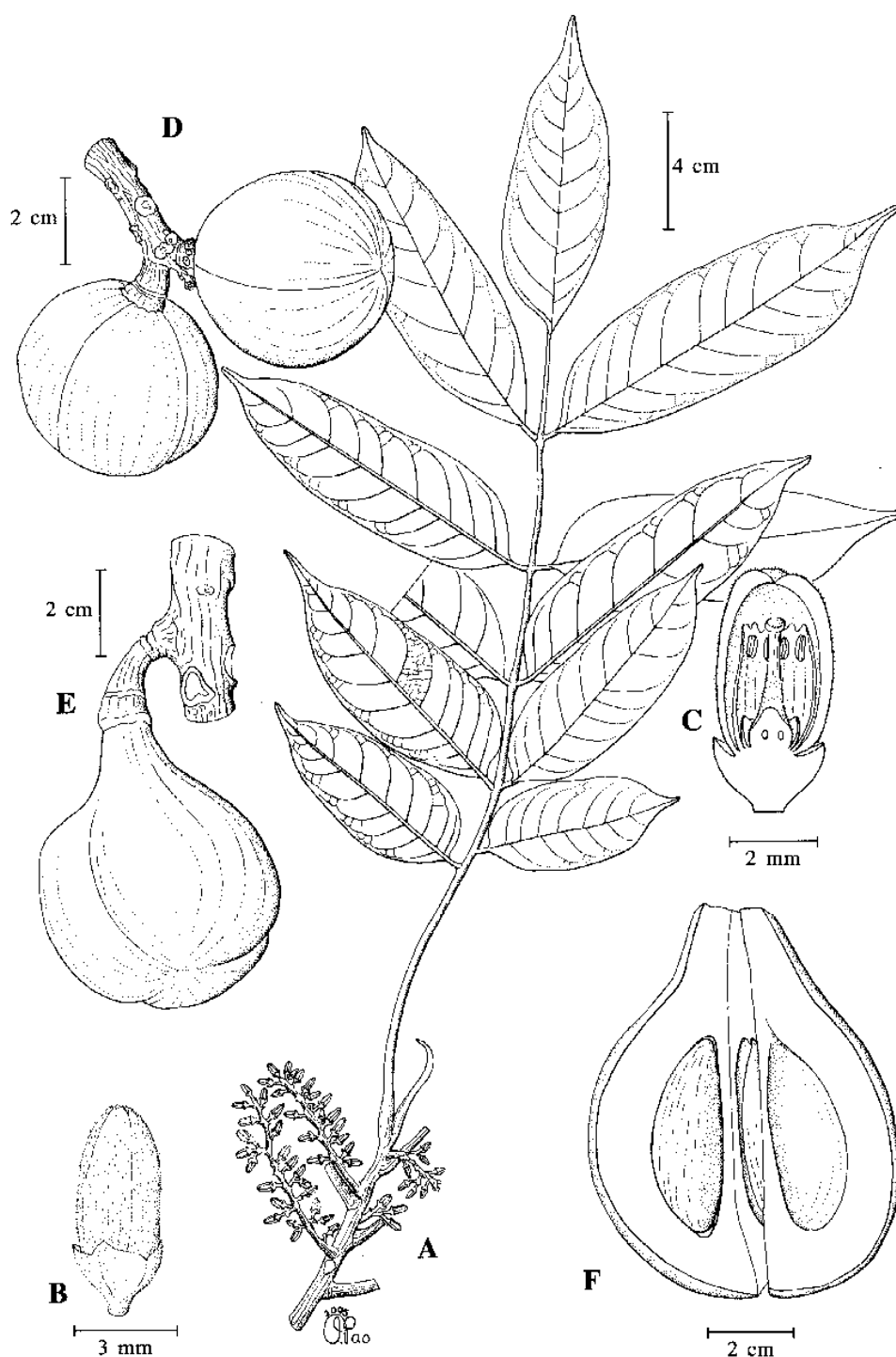


Fig. 22. *Dysoxylum cyrtobotryum*. A, flowering (female) leafy twig; B, female flower bud; C, longitudinal section of female flower bud; D, unlobed fruits; E, 3-lobed fruit; F, dehiscent fruit showing arilate seeds. (A–C from McDonald & Ismail 4915, D from S 48331, E from Kostermans 212, F from Jacobs 8355.)

Vernacular names. Sabah—*binkang* (Dusun Lahad Datu), *kamoayau burong* (Malay, Sandakan), *lantupak* (Malay), *tantau* (Dusun Ranau). Sarawak—*bunya* (Iban), *kelampu* (Iban), *segera* (Iban).

Distribution. SE Asia to Nicobars, Andamans, Sumatra, Peninsular Malaysia, Java, Lesser Sunda Islands (Bali, ?Flores), Borneo and the Philippines. In Borneo, known in Sabah from Beaufort, Keningau, Kinabatangan, Kota Belud, Kota Kinabalu, Lahad Datu, Papar, Ranau, Sandakan, Tambunan, Tawau, Tenom and Tuaran districts (e.g., *Mabberley 1713*, *SAN 29307*, *SAN 33014*, *SAN 84806* and *SAN 116878*) and in Sarawak from Bau, Kapit, Kuching, Lawas, Limbang, Lubok Antu, Lundu, Marudi and Miri districts (e.g., *Mabberley 1587*, *S 34043*, *S 36267*, *S 42941* and *S 49572*). Also occurring in Brunei (e.g., *BRUN 692*) and Kalimantan (e.g., *Kostermans 9795* and *McDonald & Ismail 4915*).

Ecology. In forests including that on limestone and in peatswamps at altitudes to 1800 m.

Notes. Specimens from Borneo sometimes have fasciated proliferating inflorescences (*cf. Dysoxylum arborescens*). The leaflets often have the facies of subglabrous *Aglaia* spp. especially *A. spectabilis* (*q.v.*), so that sterile material can readily be confused, though the latter differ in having truly imparipinnate leaves and the former usually have a few simple hairs as opposed to stellate hairs or scales.

I am still not altogether convinced that this species as defined here is homogeneous in that upland plants from Borneo with smaller leaves and thicker leaflets resembling those of *D. rugulosum* (e.g., *Mabberley 1587 & 1713*, *S 33824* *SAN 32315*) seem to be distinct, though they are apparently linked by intermediate specimens to the main corpus of material. There are also small trees from both Sabah (e.g., *SAN 47780*, *SAN 59456*, *SAN 62438*, *SAN 91089*, *SAN 92499*, *SAN 93841* and *SAN 114495*) and Sarawak (e.g., *S 26134*, *S 27866*, *S 39037*, *S 42072*, *S 42380* and *S 42941*) as well as Brunei (e.g., *Dransfield JD 7276*) with strikingly large leaflets (*cf. Chisocheton patens*, *Dysoxylum rugulosum*, *Walsura grandifolia*) drying a bilious yellow-brown, largely known from fruiting specimens and whose status is even less clear: narrow-leafleted forms (e.g., *SAN 59456* and *Sugau et al. 312*) match the type of *D. alternatum* Ridl. from Peninsular Malaysia and closely approach *Dysoxylum* sp. 3 of *Flora Malesiana*. A number of taxa may eventually be distinguishable, but the complex needs analysis in the field.

9. *Dysoxylum densiflorum* (Blume) Miq.

(Latin, *densiflorus* = with closely packed flowers)

Sect. *Dysoxylum*

Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 9; King *op. cit.* 46; Ridley *op. cit.* (1922) 396; Backer & Bakhuizen *f. op. cit.* 122; Mabberley *op. cit.* (1989) 243; Whitmore, Tantra & Sutisna *op. cit.* 231; Mabberley *et al. op. cit.* 81; Turner *op. cit.* 341; Coode *et al. (eds.) op. cit.* 205; PROSEA 5, 3 (1998) 200; Beaman & Anderson *op. cit.* 131. **Basionym:** *Epicharis densiflora* Blume, Bijdr. Fl. Ned. Ind. (1825) 167. **Type:** *Blume s.n.*, Java, G. Salak (holotype L [Acc. No. 903257823]). **Synonyms:** *Guarea densiflora* (Blume) Spreng. *op. cit.* 251; *Alliaria densiflora* (Blume) Kuntze *op. cit.* 109; *Dysoxylum cauliflorum* var. *tomentellum* Stapf, Trans. Linn. Soc. Bot. 4 (1894) 138, Merrill *op. cit.* (1921) 320; *Dysoxylum elmeri* Merr. *op. cit.* (1929) 121.

Tree to 30(–45) m tall; clear bole to 13 m tall and 65 cm diameter; buttresses to 3.5 m tall, forming plank-roots to 5 m long at base. **Bark** grey-green, smooth and lenticellate to fissured or flaking, the more or less rectangular flakes leaving brown patches; inner bark thin, fibrous and pinkish, red-mottled, creamy-yellow inside. **Sapwood** straw. **Twigs** 6–8 mm diameter apically, grey-brown with prominent petiole scars and sometimes white latex. **Apical buds** with fist-shaped young leaves. **Leaves** in dense terminal spirals, to 150 cm long, imparipinnate; petioles 6–11 cm long, terete to grooved adaxially proximally, swollen somewhat at base, more or less finely pubescent; leaflets shiny midgreen above, paler and more or less pubescent below, sometimes conspicuously brown-pubescent; lateral leaflets 5–8 on each side of rachis, opposite to subopposite; blades of apical leaflets elliptical-ovate to elliptical-obovate, symmetrical, the lateral ones elliptical-ovate, the most proximal ones ovate and smallest, 14–20 × 5–8 cm, base obtuse to subcordate (to cuneate in apical leaflet), markedly asymmetrical especially in most proximal leaflets, apex acuminate; venation brochidodromous; lateral veins *c.* 14 on each side of midrib, arcuate, drying paler above, prominent and pubescent below; petiolules 1–4(–6) mm (to 12 mm in apical leaflet) long. **Inflorescences** racemose or narrowly thyrsoid, to 10 cm long, solitary or fasciculate in axils or on twigs, sericeous; bracts *c.* 2 mm long, triangular, pubescent. **Flowers** sometimes in sessile cymules, sweetly scented; pedicels 2–3 mm long, pubescent; calyx campanulate (= bell-shaped), *c.* 2.5 mm tall, appressed pubescent, deeply 4-lobed, lobes acute; petals 4, linear-oblong, 8–11 mm long, acute, imbricate, sparsely hairy outside, white; staminal tube subglabrous outside, pilose inside, conspicuously 8(or 9)-striate, white, margin 8-lobed, lobes subtruncate, emarginate or irregularly toothed, anthers 8 (or 9), oblong-ovate, *c.* 1 mm long, alternating with lobes; disc 3–4 mm tall, glabrous or sparsely hairy inside, margin irregularly lobed; ovary (3 or) 4-locular, appressed pubescent, style appressed pubescent, stylehead discoid, yellow. **Infructescences** to 10 cm or fruits solitary; rachis to 9 mm diameter. **Fruits** pyriform to fusiform (= spindle-shaped), to 4 × 2 cm, (3 or) 4-valved, silky, grey-green hairy; pericarp soft, with white latex. **Seeds** 2–4; testa black, partially enveloped in a white hilar (?) aril.

Vernacular names. Sabah—*langkabang* (Dusun Bundu Tuhan). Sarawak—*segera* (Iban).

Distribution. S Myanmar, China (Yunnan), Thailand, Sumatra, Peninsular Malaysia, Borneo, the Philippines (Palawan), Java, Lesser Sunda Islands (Bali, Lombok, Flores) and Sulawesi. In Borneo, known in Sabah from Beaufort, Keningau, Lahad Datu, Ranau, Sandakan, Semporna and Tawau districts (e.g., *Mabberley 1717*, *SAN 30507*, *SAN 31414*, *SAN 73180* and *SAN 89413*) and in Sarawak from Bau, Belaga, Kapit, Kuching, Lubok Antu, Lundu, Miri and Serian districts (e.g., *Mabberley 1608*, *Pennington 7986*, *S 18258*, *S 31830* and *S 37991*). Also occurring in Brunei (e.g., *Coode 7791*) and Kalimantan (e.g., *Leighton 163*).

Ecology. Rain forest at altitudes to 1700 m.

10. *Dysoxylum excelsum* Blume

(Latin, *excelsus* = tall)

Sect. *Dysoxylum*

Bijdr. Fl. Ned. Ind. (1825) 176; Backer & Bakhuizen *f. op. cit.* 124; Mabberley *op. cit.* (1989) 244; Whitmore, Tantra & Sutisna *op. cit.* 231; Mabberley *et al. op. cit.* 109; Turner *op. cit.* 341; Coode *et al. (eds.) op. cit.* 205; PROSEA 5, 3 (1998) 201. **Type:** *Blume s.n.*, Java, Bogor, Tjiandjur, 1824,

(holotype L [Acc. No. 903295149], isotypes ?BO, L [Acc. No. 903295141 & 903295152], ?NY, ?P). **Synonyms:** *Macrocheton excelsum* (Blume) M.J.Roem. *op. cit.* (1846) 104 ('*Macrochiton*'); *Dysoxylum procerum* Hiern var. *motleyanum* C.DC. *op. cit.* (1878) 487, Merrill *op. cit.* (1921) 320, Masamune *op. cit.* 376; *Dysoxylum motleyanum* (C.DC.) Ridl. *op. cit.* (1930) 364; *Dysoxylum havilandii* Ridl. *op. cit.* (1930) 365. (For complete synonymy cf. Mabberley *et al. op. cit.*)

Tree to 36 m tall; bole to 80 cm diameter; buttressed to 3 m tall, to 2.5 m out, concave. **Bark** smooth to slightly flaking, lenticellate; inner bark reddish brown with resinous smell. **Sapwood** fawnish white; heartwood brownish red. **Twigs** 5–9 mm diameter apically, lenticellate, more or less pubescent when young. **Apical buds** with fist-shaped young leaves. **Leaves** spirally arranged, 25–90 cm long, subparipinnate with terminal scar; petioles 5–10 cm long, more or less puberulent, somewhat flattened adaxially, weakly swollen at base; leaflets subcoriaceous, glabrous to rufescent-pubescent below, especially on veins; lateral leaflets 2–4 (or 5) on each side of rachis, opposite to alternate; blades ovate-elliptical to ovate-lanceolate, 10–25(–51) × 4–10(–21) cm (the most distal the largest), base more or less symmetrical, acute to attenuate, apex obtuse to acuminate; lateral veins 9–12 on each side of midrib, arcuate, obscurely anastomosing at margin, impressed above, prominent below like the midrib when dry; petiolules 5–15 mm long, sulcate when dry. **Inflorescences** to 100 cm long, but usually less and sometimes (in females) as short as 10 cm, axillary to supra-axillary; axes more or less densely rufescent-pubescent, most proximal branches to 20 cm long with secondary branches to 3 cm long, bearing cymes of 1–3 flowers; bracts triangular, c. 1.5 mm, pubescent. **Flowers** sweetly scented; pedicels c. 1 mm long, articulated with pseudopedicels to 3 mm long; calyx continuous with pseudopedicel, shallowly cup-shaped, 1–2 mm tall, 4–5 mm diameter, pubescent outside, pinkish, margin rather irregularly 4(or 5)-toothed; petals 4 (or 5), narrowly oblong, 6–15 × 3–4 mm, valvate, minutely sericeous outside, creamy or pinkish white; staminal tube glabrous or weakly puberulent inside or outside, white, margin truncate to weakly 8(–10)-crenate, anthers 8 (or 10), c. 1 mm long, included, glabrous; disc up to half as long as staminal tube, with descending hairs inside and more or less 8(–10)-toothed margin, markedly pilose; ovary densely sericeous, 3- or 4-locular, each locule with 1 or 2 ovules, style glabrous in distal half, otherwise sericeous, stylehead discoid to subcapitate. **Infructescences** more or less unbranched. **Fruits** depressed globose to pyriform, to 4 × 5(–7.5) cm, 3- or 4-lobed, glabrous to scurfy, chestnut-brown when ripe. **Seeds** 1–4, subreniform, c. 2.5 × 1.5 cm, pendent on funicles at fruit dehiscence; testa bright red; hilum white.

Vernacular names. Sabah—*lantupak* (Dusun Labuk), *lombunan* (Dusun Sandakan). Sarawak—*durong* (Kelabit), *segera* (Iban).

Distribution. Sri Lanka, Nepal and NE India, S China and Indo-China throughout Malesia to Solomon Islands. In Borneo, known in Sabah from Beaufort, Lahad Datu, Sandakan, Sipitang and Tawau districts (e.g., Mabberley 1657, SAN 34335, SAN 42912, SAN 87714 and SAN 90408) and in Sarawak from Kapit, Kuching, Lawas, Lubok Antu and Tatau districts (e.g., S 16466, S 27944, S 20063, S 36386 and S 37327). Also occurring in Brunei (e.g., BRUN 692) and Kalimantan (e.g., Kostermans 6219).

Ecology. Rain forest including riverine and swamp forest and that on limestone at altitudes to 1000 m.

Notes. Although reasonably uniform in Borneo, *Dysoxylum excelsum* as presently understood, is, across its range, a complex of forms insufficiently differentiated from one

another to make possible an arrangement of closely related species or, indeed, of infraspecific taxa associated with differences in geography or ecology. In Borneo, there are some rather characteristically pubescent forms (described as *D. havilandii*) but these can be matched with materials from Java, Sumatra and Peninsular Malaysia as well as mainland Asia.

11. *Dysoxylum flavescens* Hiern

(Latin, *flavescens* = yellowish; referring to the petals)

Sect. *Cyrtochiton*

In Hooker *f.*, Fl. Br. Ind. 1 (1875) 549; King *op. cit.* 49; Ridley *op. cit.* (1922) 396; Mabblerley *op. cit.* (1989) 244; Whitmore, Tantra & Sutisna *op. cit.* 231; Mabblerley *et al. op. cit.* 128; Turner *op. cit.* 341; Coode *et al.* (eds.) *op. cit.* 205; PROSEA 9, 3 (1998) 201. **Type:** Maingay 3341 [= *Kew Distr.* 321], Peninsular Malaysia, Malacca (holotype K).

Tree to 33 m tall; bole to 70 cm diameter; buttresses to 1 m tall and 60 cm out. **Bark** superficially cracked, brown with star-shaped pustulate lenticels; inner bark pinkish to orangeish. **Sapwood** straw; heartwood pale reddish brown, hard, aromatic. **Twigs** *c.* 7 mm diameter apically. **Apical buds** *stiletto-like*. **Leaves** *spirally arranged*, to 48 cm long, *paripinnate*; petioles 8–13 cm long, flattened adaxially, swollen and often blackish (when dry) at base; *leaflets* 3–5 on each side of rachis, subcoriaceous, subopposite, *glabrous*, often shiny above; blades narrowly elliptical-ovate, 7.5–13 × 3.4–4.7 cm, base rounded to subcuneate, more or less asymmetrical, apex acuminate; lateral veins 13–19 on each side of midrib, indistinct, subsquarrose and spreading, inarched only near margin but not looped; *intercostal venation scarcely distinguishable from lateral veins*; petiolules 3–4(–9) mm long, blackened at base when dry. **Inflorescences** 5–10 cm long, *subspicate* with fascicles of 1 or a few sessile flowers; bracts triangular, *c.* 0.5 mm. **Flowers:** *calyx* *c.* 2.5 mm diameter, puberulent outside, confluent with pseudopedicel *c.* 1 mm long, *margin deeply 4-lobed*; *petals* 4, *c.* 7 mm long, creamy-yellow, subglabrous to puberulent outside; staminal tube thick, tough, weakly pilose distally, margin crenate, *anthers* 8, ovate, included; disc shortly cup-shaped, glabrous, fleshy; *ovary* pubescent, *4-locular*, each locule with 2 collateral ovules, style pubescent in proximal half, stylehead discoid. **Fruits** depressed globose, at least 4 cm diameter, weakly stipitate, reddish orange. **Seed** brown to black with small ariloid hilum on one side; testa apparently largely pachychalazal.

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, recorded in Sabah from Papar district (e.g., *SAN* 32207) and in Sarawak from Kuching district (e.g., *SAN* 37981 and *Fuchs* 21009). Also occurring in Brunei (e.g., *Kirkup DK* 631) and Kalimantan (e.g., *Kostermans* 7950).

Ecology. Rain forest at altitudes to 1700 m. Very rarely collected.

12. *Dysoxylum grande* Hiern

(Latin, *grandis* = large)

Sect. *Cyrtochiton*

In Hooker f., Fl. Br. Ind. 1 (1875) 547; Mabberley, *op. cit.* (1989) 244; Whitmore, Tantra & Sutisna *op. cit.* 231; Mabberley *et al. op. cit.* 117; Turner *op. cit.* 341; Coode *et al. (eds.) op. cit.* 205; PROSEA 5, 3 (1998) 201; Beaman & Anderson *op. cit.* 131. **Type:** Bruce in *EIC* 4883, India, Assam, Sylhet (holotype K-W; isotypes BM, P). **Synonym:** *Alliaria grandis* (Hiern) Kuntze *op. cit.* 109. (For full synonymy *cf.* Mabberley *et al. op. cit.*)

Tree to 39 m tall; bole to 70 cm diameter, with plank buttresses to 2 m tall and 7.5 m out. **Bark** smooth to dippled, greyish brown, lenticellate; inner bark with cream and pinkish purple tangential bands. **Sapwood** yellow-brown. **Twigs** 1.3–2 cm diameter apically, with wide pith, often fulvous-tomentellous. **Apical buds** with long stiletto-like young leaves. **Leaves** spirally arranged, to 100 cm long, with apical stub or spike, one of the lateral leaflets often appearing terminal; petioles 10–15 cm long, somewhat 3-angled, more or less fulvous-pubescent, base swollen; leaflets brittle when dry, upper surface reddish brown in young leaves, rugulose with minute black glandular dots, glabrous except midrib and veins sometimes yellow-pubescent, lower surface gland-dotted, subglabrous to densely yellow-pubescent; lateral leaflets 6–9 on each side of rachis, alternate or opposite; blades oblong, the most proximal ones sometimes lanceolate, 10–19 × 3.5–6 cm, base rounded to shortly cuneate, margin subrevolute, apex acuminate to subcaudate; lateral veins 23–25 on each side of midrib, subsquarrose, arching but not looping at margin; petiolules 5–9 mm long, sulcate, more or less pubescent. **Inflorescences** narrow (unbranched), to 10 cm long in females, to 30 cm long with branches to 5 cm in males; axes angled, more or less finely tomentose; bracts and bracteoles c. 0.5 mm, ephemeral. **Flowers** subsessile in cymules of 3 or 4, fragrant; calyx shallowly cup-shaped, c. 4.5 mm tall (c. 2 mm in males), c. 7 mm diameter (c. 5 mm in males), more or less pubescent outside, margin 4-lobed; petals 4, oblong, c. 9 mm long (c. 7 mm in males), densely tomentose outside, creamy-yellow; staminal tube minutely pubescent outside, glabrous inside, margin with 8 short, broadly triangular lobes, anthers 8, oblong, c. 1.2 mm long, included; disc shortly cylindrical, c. 1.3 mm tall, often closely enveloping ovary, subglabrous outside, densely long yellow pilose inside; ovary densely pilose, (3 or)4(or 5)-locular, each locule with (?)1 ovule, style 4-angled, pubescent in proximal half, stylehead cylindrical-capitate, with basal annulus. **Infructescences** sparingly branched, with watery sticky latex. **Fruits** 1–4 on stout peduncles, depressed globose, 5–8 × 7–11 cm, apically dimpled, 3–5-sulcate, orange. **Seeds** 1–4 (or 5), c. 2.5 cm long, with thick (?)sarcotesta.

Distribution. India (Assam) and S China (including Hainan), Thailand, Sumatra, Peninsular Malaysia, Borneo and probably in the Philippines. In Borneo, known in Sabah from Kinabatangan, Lahad Datu and Ranau districts (e.g., Mabberley 1712, SAN 25400, SAN 38522, SAN 56723 and SAN 74136) and in Sarawak from Kapit and Kuching districts (e.g., S 19604 and S 44087). Also occurring in Kalimantan (e.g., Church *et al.* 616). Not yet recorded from Brunei.

Ecology. Rain forest, especially hill forest at altitudes to 1400 m.

13. *Dysoxylum macrocarpum* Blume

(Greek, *makro* = large, *karpōs* = fruit; large-fruited)

Sect. *Cyrtochiton*

Bijdr. Fl. Ned. Ind. (1825) 175; Ridley *op. cit.* (1930) 365; Backer & Bakhuizen *f. op. cit.* 123; Anderson *op. cit.* (1980) 252; Mabberley *op. cit.* (1989) 244; Whitmore, Tantra & Sutisna *op. cit.* 232; Mabberley *et al. op. cit.* 116; Turner *op. cit.* 341; Beaman & Anderson *op. cit.* 131. **Lectotype** (designated here): *Blume s.n.* [‘572’], Java, G. Salak, (L [Acc. No. 903295229]; isoelectotype L [Acc. No. 903295217]).

Tree to 33 m tall; bole to 50 cm diameter with plank buttresses to 2 m tall and 1 m out. **Bark** smooth, grey-green, faintly hooped and finely lenticellate; inner bark cream, flecked orange, fibrous within. **Sapwood** pale yellow. **Twigs** 7–13 mm diameter apically, with wide pith, conspicuously set with petiole scars and lenticellate, yellowish when dry. **Apical buds** spike-like, to 5 cm long. **Leaves** spirally arranged, to 100 cm long, more or less imparipinnate; petioles to 38 cm long, swollen at base; leaflets subglabrous, drying ochreous, dull and thin when fresh; lateral leaflets 3 or 4 on each side of rachis, alternate; blades elliptical-ovate, to 30 × 10 cm, base subcuneate, apex acuminate; lateral veins 13–18 on each side of midrib, ascendant, looping indistinctly at margin, prominent below; intercostal venation obscure; petiolules to 6 mm long, slightly swollen. **Inflorescences** to 25 cm long, with spreading branches. **Flowers** foetid; calyx with irregular margin; petals 4, finely hairy, creamy-white to orangeish; staminal tube hairy inside, margin more or less truncate, anthers 8 (or 9), inserted within staminal tube; disc more or less truncate; ovary pubescent, style terete, stylehead discoid. **Infructescences**: axes to 8 mm diameter, with 1–3 fruits. **Fruits** globose to pyriform, to 10 cm diameter, 8-locular, shallowly ridged, bright orange-red; pericarp with white latex; mesocarp fleshy, orange-yellow. **Seeds** 1 or 2 with dark brown testa and thick pale orange (?) aril.

Distribution. Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines and Sulawesi. In Borneo, known in Sabah from Keningau, Papar and Sandakan districts (e.g., SAN 28393, SAN 61641, SAN 68028 and SAN 78451) and in Sarawak from Kuching, Marudi, Miri and Serian districts (e.g., Burley & Lee 319, S 12635, S 24421, S 29861 and S 38930). Also occurring in Kalimantan (e.g., Kostermans 21585). Not yet recorded from Brunei.

Ecology. Forests including riparian ones and those on limestone at altitudes to 1800 m.

14. *Dysoxylum magnificum* Mabb.

(Latin, *magnificus* = magnificent)

Sect. *Dysoxylum*

Blumea 38 (1994) 309; Mabberley *et al. op. cit.* 113. **Type:** Sibat S 24337, Borneo, Sarawak, Kuching district (holotype FHO; isotypes K, L, SAN, SAR, SING).

Tree to 15(–25) m tall; all parts onion-scented when bruised; bole to 25 cm diameter, fluted with buttresses to 30 cm tall and out. **Bark** smooth to cracking into small blocks, often hooped and with prominent brown lenticels, brownish; inner bark pinkish brown. **Sapwood** pale cream. **Twigs** smooth to striate, pale brown, 9–12 mm diameter apically, rusty-brown velutinous when young. **Apical buds** densely velutinous, fist-shaped young leaves. **Leaves** in lax terminal spirals, to 100 cm long, not strictly paripinnate; petioles 8–14 cm long, flattened to channelled adaxially, more or less densely velutinous, swollen at base; leaflets 5 or 6 on each side of rachis, opposite to alternate, one often appearing apical through fall of spike, leaving scar on other side, the largest the most distal, somewhat coriaceous, upper surface glossy and glabrous save sometimes for the pubescent midrib, lower surface brown-

velutinous, especially on veins; *blades oblong*, 17–29 × 6–14 cm, base obtuse, apex shortly acuminate to cuspidate; veins somewhat sunken above, prominent below; lateral veins 12–14 on each side of midrib, obtuse, inarching only at margin, some secondary ones, particularly proximally, almost as conspicuous; *intercostal venation subscalariform*; petiolules 4–8 mm long, somewhat sulcate. **Inflorescences** to 60 cm long, *spicate* or with *few subsquarrose branches to 10 cm long*; axes more or less densely brown-velutinous. **Flowers:** bracteoles lanceolate, 4–6 mm, densely pilose; *calyx* shallowly cup-shaped, *c.* 2.5 × 5 mm, more or less velutinous outside, *margin subirregularly 5-crenate*; *petals* 5, narrowly spatulate, *c.* 12 × 2.5 mm, valvate, white, densely appressed pubescent outside, tips acute, thickened; staminal tube white, glabrous, margin subcrenulate, *anthers* 10, narrowly oblong, *c.* 1.5 mm long, sublocellate, glabrous, inserted *c.* 3 mm within staminal tube, free filament *c.* 0.5 mm long; disc cylindrical, *c.* 2.5 mm tall, densely appressed hairy on both surfaces; *ovary* densely appressed hairy, (?) *3-locular*, each locule with (?) 2 ovules, style terete, appressed pubescent, stylehead capitate *c.* 0.8 mm diameter. **Fruits** *depressed globose*, *at least 8 cm diameter*, deeply sunken between the 2 or 3 fertile locules, brown and velvety when young, pale cream when ripe. **Seeds** subhemispherical, *c.* 2 cm diameter, flattened adaxially, covered with shining thick sarcotesta (?), pink when mature.

Vernacular name. Sarawak—*empawas* (Iban).

Distribution. Sumatra and Borneo (Sarawak only). Known in Sarawak from Kapit, Kuching and Lundu districts (e.g., *Jacobs* 5226, *Mabberley* 1577, *Pennington* 8014, *S* 37972 and *S* 76713).

Ecology. Rain forest at altitudes to 500 m.

15. *Dysoxylum mollissimum* Blume

(Latin, *mollissimus* = very soft; referring to the pubescence of the leaves)

Sect. *Dysoxylum*

Bijdr. Fl. Ned. Ind. (1825) 175; Backer & Bakhuizen *f. op. cit.* 123; Mabberley *op. cit.* (1989) 245; Whitmore, Tantra & Sutisna *op. cit.* 232; Mabberley *et al. op. cit.* 90; Turner *op. cit.* 341; PROSEA 5, 3 (1998) 201; Beaman & Anderson *op. cit.* 131. **Lectotype** (selected here): *Blume s.n.* ['602'], Java, G. Salak (L [Acc. No. 903295276]; isoelectotypes L [Acc. No. 903295281 & 903295282]). **Synonyms:** *Trichilia mollissima* (Blume) Spreng. *op. cit.* 252; *Hartighsea mollissima* (Blume) A.Juss., Mém. Mus. Hist. Nat. Paris 19 (1832) 228; *Alliaria mollissima* (Blume) Kuntze *op. cit.* 109; *Dysoxylum mollissimum* Blume var. *halmaheirae* Miq. & var. *sumatranum* Miq. *op. cit.* (1868) 18; *Dysoxylum molle* Miq. *op. cit.* (1868) 18; *Dysoxylum teysmannii* C.DC. *op. cit.* (1878) 510; *Alliaria teysmannii* (C.DC.) Kuntze *op. cit.* 109.

Distribution. From India (Sikkim and Assam) and S China, Malesia, to Australia and W Pacific.

Uses. This species was one of the biggest trees of Java, though it has not been collected in west Java since before the 1860s. Its wood has been used sporadically for houseposts and other construction and it is recorded as an important commercial lumber tree from which

boards are made in Hainan. *Dysoxylum mollissimum* subsp. *molle* (Miq.) Mabb. is the red bean, kedgy-kedgy or pencil cedar of tropical Australia used in cabinet work.

Notes. Two subspecies, subsp. *molle* and subsp. *mollissimum*, are recognised. The first differs from the second in its pustular lenticellate fruit (vs. smooth), and does not occur in Sabah and Sarawak.

subsp. **mollissimum**

Tree to 34(–60) m tall; clear bole to 25 m tall and 1.5 m diameter, fluted; buttresses to 2(–5) m tall, to 1 m out, concave. **Bark** grey-brown, smooth with elongated brown lenticels, becoming pustular and cracking vertically or scaling; inner bark yellow-brown, flecked orange. **Sapwood** pale brown, often with strong smell of garlic, onions, potatoes or turnips; heartwood hard, deep red. **Twigs** with conspicuous petiole scars, brown or reddish, often conspicuously lenticellate, to 10 mm diameter apically, glaucous to reddish, subglabrous to densely yellow-pubescent. **Apical buds** with fist-shaped young leaves. **Leaves** spirally arranged, 25–95 cm long, imparipinnate, with the distal leaflets developing more or less some time after the more proximal ones; petioles 5–10 cm long, subglabrous to softly pubescent, often lenticellate, somewhat flattened adaxially or subterete, base weakly swollen to clasping; leaflets glabrous to sparsely pubescent, especially on veins above, subglabrous to densely soft-pubescent below, rarely with domatia, the apical one often and the most distal laterals sometimes falling before developing; lateral leaflets 14(–17) on each side of rachis, opposite to subopposite; blades oblong to ovate, 13–16 × 4–5 cm, the most proximal smaller, c. 6.5 × 3.5 cm, base symmetrical to asymmetrical, obtuse to subcordate distally, acute to cuneate proximally, apex apiculate to acute; lateral veins 10–12 on each side of midrib, prominent below, mostly more or less bifid 2/3 from midrib and anastomosing; petiolules 2–7 mm long. **Inflorescences** to 60 cm long, axillary to supra-axillary, pendent, 1- or 2-branched, the primary branches to 12 cm long, the more distal shorter, the secondary ones to c. 1 cm long bearing multiflowered fascicles; bracts and bracteoles 2 or 3, triangular, c. 1 mm long, more or less densely pubescent. **Flowers** sweetly scented; pedicels 0–1 mm long; calyx salver-shaped to shallowly cup-shaped, c. 1 × 1.5 mm, more or less densely appressed pubescent, 4-lobed, the lobes irregularly triangular; petals 4 (or 5), linear, 8–12 mm long, cream, more or less sparsely pubescent outside, somewhat imbricate at apices, adnate to staminal tube in proximal half; staminal tube hairy on both sides, especially villous inside, weakly ribbed, the margin subtruncate to 8-lobed, the lobes somewhat emarginate, anthers 8, oblong, c. 0.5 mm long, weakly locellate, glabrous, included; disc cylindrical, 2–4 mm long, glabrous to pubescent, green, margin irregularly 4-toothed; ovary subsericeous, 4-locular, each locule with 1 ovule, style terete, sericeous to villous in proximal half, stylehead subdiscoid to short-cylindrical. **Fruits** depressed globose, 1.5–2.5 cm diameter, glabrous, 4-valved, reddish brown, smooth; pericarp with white latex. **Seeds** 1–4, to 16 mm long, planoconvex, with red aril.

Distribution. India (Assam), China (Yunnan, Hainan), Myanmar, Sumatra, Peninsular Malaysia, Java (including Kangean Archipelago), Borneo (Sabah and Sarawak), the Phillipines (Luzon, Mindanao) and Lesser Sunda Islands (Bali). In Sabah recorded from Kinabatangan, Ranau and Tenompok districts (e.g., Clemens 26662, Clemens 28520, S 10648, SAN 74109 and SAN 142663) and in Sarawak from Bau district (e.g., S 37541).

Ecology. In forests at altitudes to 1900 m, including coastal forests behind mangrove.

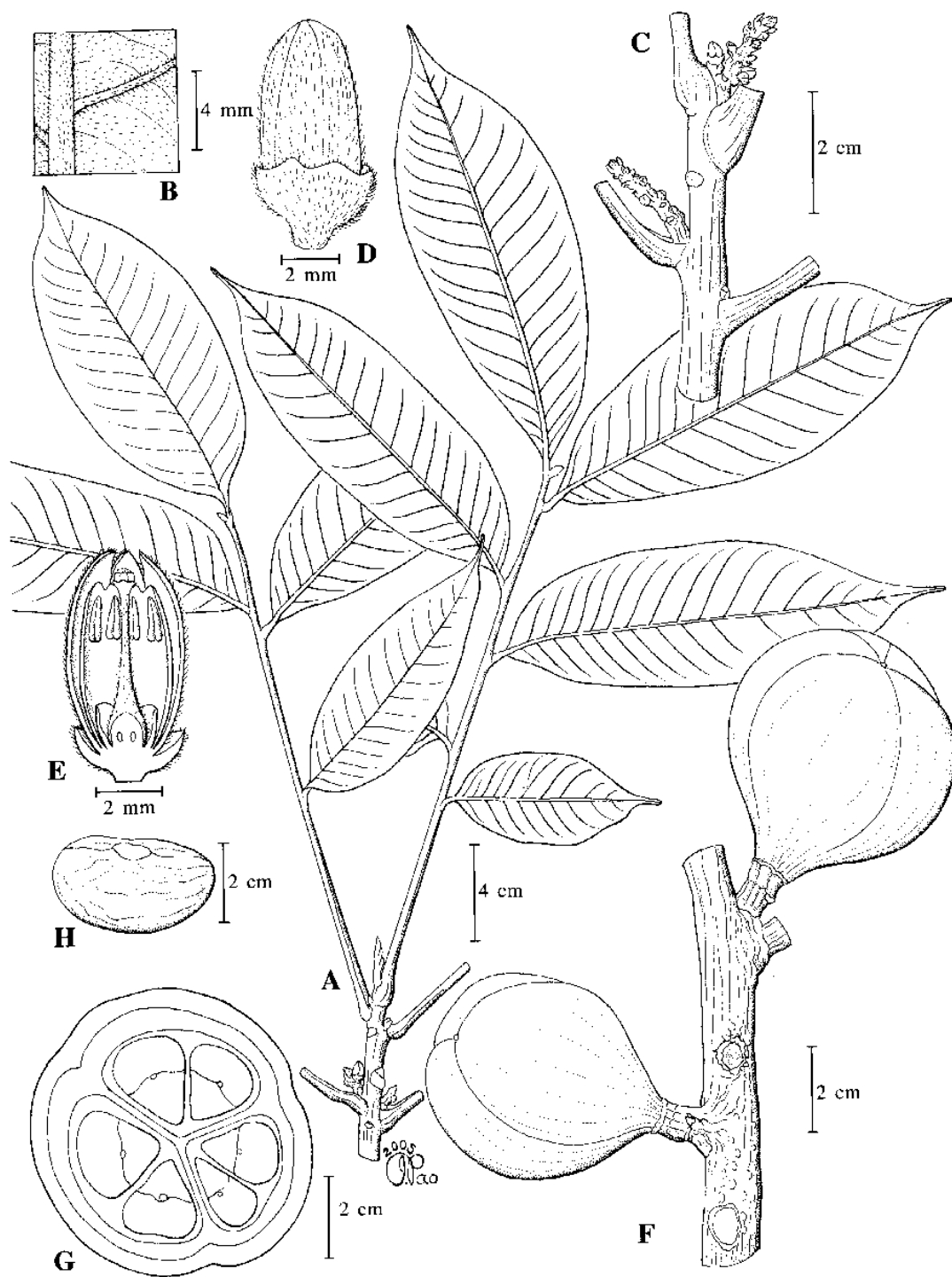


Fig. 23. *Dysoxylum pachyruche*. A, flowering leafy twig; B, detail of leaflet lower surface showing indumentum; C, inflorescences; D, flower bud; E, longitudinal section of flower bud; F, fruits; G, cross-section of fruit; H, seed. (A–B from *S* 14609, C–E from *S* 36905, F from *S* 37751, G–H from *S* 40422.)

16. *Dysoxylum oppositifolium* F.Muell.(Latin, *oppositus* = opposite, *folium* = leaf; with opposite leaves)**Sect. *Cyrtochiton***

Fragm. 5 (1866) 177; Mabberley *et al. op. cit.* 122; PROSEA 5, 3 (1998) 201. **Type:** *Dallachy s.n.*, Australia, Queensland, Rockingham Bay (holotype MEL; isotypes [?] BRI, E, K, NSW). **Synonym:** *Alliaria oppositifolia* (F.Muell.) Kuntze *op. cit.* 109.

Small tree to 10(–30) m tall; bole to 40 cm diameter; buttresses to 1.5 m tall. **Bark** flaking, yellow-brown; inner bark reddish. **Twigs** with conspicuous petiole scars, 5–7 mm diameter apically, pale brown when dry, more or less brownish-puberulent. **Apical buds** *stiletto-like*, to 8 cm long. **Leaves** *opposite*, 15–45 cm long, *paripinnate with apical scar*; petioles 6–10 cm long, drying yellowish, swollen at base, subpuberulent; leaflets 3–6 on each side of rachis, subcoriaceous, opposite or the more proximal sometimes alternate, *subglabrous to pilose on midrib above and on lower surface*, particularly the veins; blades oblong to elliptical, the subapical the largest, (4–)8–17 × (2–)3.5–5.5 cm, base more or less markedly asymmetrical, rounded to acute, apex obtuse to shortly acuminate; lateral veins 12–14 on each side of midrib, arcuate, obscurely looped, somewhat impressed above, prominent below; petiolules 3–6 mm long, weakly swollen. **Inflorescences** 5–9 cm long, *racemose or thyrsoid*, axillary or in axils of petiole scars; axes pubescent; *branches to 8 mm long*, bearing 3-flowered cymules. **Flowers:** pedicels *c.* 1 mm long, articulated with very short pseudopedicels; *calyx c.* 3 mm diameter, puberulent outside, *margin 4-toothed*, the teeth *c.* 1.5 mm long; *petals 4*, oblong, *c.* 7 × 3–3.5 mm, obtuse, subpubescent outside, creamish; staminal tube glabrous or very sparsely pubescent apically outside, margin subcrenate, *anthers 8*, ellipsoid, *c.* 1 mm long, included; disc cup-shaped, *c.* 2 mm tall and diameter, glabrous outside, subpubescent inside, margin somewhat undulate; *ovary* pubescent, *4-locular*, style terete, pubescent in proximal half, stylehead discoid. **Fruits** apparently pyriform, *c.* 3 cm diameter, 4-valved, veined, orange-black turning to black when dry. **Seeds** 2–4, ellipsoid, *c.* 1 cm long, with red (?) sarcotesta.

Distribution. Borneo (Sabah only), the Philippines, New Guinea and NE Australia. In Sabah rare, known only by two collections from Semporna district (*SAN 40823* and *SAN 48801*).

Ecology. Rain forest, at 300–500 m altitude.

17. *Dysoxylum pachyrhache* Merr.

Fig. 23.

(Greek, *pachy-* = thick, *rhachis* = axis; referring to the stout inflorescence axes)**Sect. *Cyrtochiton***

PEB (1929) 120; Masamune *op. cit.* 376; Whitmore, Tantra & Sutisna *op. cit.* 232; Mabberley *et al. op. cit.* 119; Coode *et al. (eds.) op. cit.* 205. **Type:** *Elmer 21692*, Borneo, Sabah, Tawau (holotype UC; isotypes A, BM, BO, BP, DS, G, GH, K, L, M, MO, NY, P, SING, U, Z). **Synonym:** *Epicharis pachyrhachis* (Merr.) Harms *op. cit.* (1940) 170.

Tree to 20 m tall; clear bole to 10 m tall and 40 cm diameter, sometimes with short buttresses. **Bark** smooth with large corky lenticels, chocolate-brown, to superficially

fissured and finely cracking; inner bark bright orange, granular. **Sapwood** pale brown; heartwood brown. **Twigs** stout, angled, with conspicuous petiole scars, greyish brown with bright brown lenticels, densely tomentose when young, 10–15 mm diameter apically. **Apical buds** *stiletto-like*. **Leaves** in *terminal spirals*, to 100 cm long, with *terminal spike or its scar*; petioles 10–16 cm long, terete to flattened adaxially, more or less densely brown tomentose, weakly swollen at base; *leaflets* subcoriaceous, glabrous except on midrib above, *softly pubescent below*; *lateral leaflets 2–4 on each side of rachis*, subalternate; blades elliptical, 12–25 × 7–12 cm, base somewhat asymmetrical, acute to rounded; *lateral veins 15–18 on each side of midrib*, spreading, inarched but not looped at margin; petiolules 5–11 mm long, drying dark brown, weakly swollen. **Inflorescences** to 8 cm long, usually much shorter, *subspicate*, with congested branchlets of subsessile flowers, axillary, supra-axillary in axils of leaves or petiole scars; axes 4–6 mm diameter, densely pubescent. **Flowers** weakly scented; *calyx* shallowly cup-shaped, 3–4 mm tall, 5–6 mm diameter, densely pubescent outside, pale brown, margin irregularly *4-lobed*; *petals 4*, 8–9 × 3 mm, densely pubescent outside, creamish; staminal tube glabrous, margin subcrenate, *anthers 8*, narrowly oblong, *c.* 1.5 mm long, inserted within the staminal tube; disc 2–3 mm tall, glabrous, margin obscurely crenulate; *ovary 4-locular*, densely appressed pubescent, style appressed pubescent at base, stylehead subcapitate, *c.* 1 mm diameter, with a basal annulus and impressions of stamens. **Fruits** solitary or in groups of 2 or 3, *subpyriform*, 5–8 × 5–8 cm, glabrous when ripe, orange-red; stipe 1–1.5 cm long; pericarp pale along sutures, to 1.5 cm thick, ochreous inside. **Seeds** orange-segment-shaped *c.* 2.5 cm long, with creamy laticiferous (?) sarcotesta.

Distribution. Endemic in Borneo. Known in Sabah from Keningau, Penampang, Sandakan and Tawau districts (e.g., *Mabberley 1659*, *SAN 35393*, *SAN 65475*, *SAN 73771* and *SAN 142589*) and in Sarawak from Kapit, Kuching, Limbang, Marudi and Miri districts (e.g., *Mabberley 1601*, *S 37751*, *S 39177*, *S 47860* and *S 48174*). Also occurring in Brunei (e.g., *Wong WKM 260*) and Kalimantan (e.g., *Ambriansyah & Arifin W 723*).

Ecology. Rain forest at altitudes to 1600 m.

18. *Dysoxylum papillosum* King

(Latin, *papillosus* = with small pimples; referring to the surfaces of dry leaflets)

Sect. *Dysoxylum*

J. As. Soc. Beng. 64, 1 (1895) 50; Ridley *op. cit.* (1922) 397; Mabberley *op. cit.* (1989) 245; Mabberley *et al. op. cit.* (1995) 116; Turner *op. cit.* 341. **Type:** *King's collector 10755*, Peninsular Malaysia, Perak (holotype CALC, *n.v.*; isotypes BM, G, K).

Small tree to 6 m tall, flowering when a metre or so tall. **Bark** grey-green; inner bark orange. **Twigs** 6–8 mm diameter apically, *tawny-tomentose*. **Apical buds** with *fist-shaped young leaves*, *densely tawny-tomentose*. **Leaves** *spirally arranged*, to 45 cm long, with *apical spike to 15 mm long or its scar*; petioles 10–14 cm long, somewhat angled, swollen weakly at base, *densely yellow-pilose*; *leaflets* coriaceous, minutely rugulose when dry, *glabrous above*, *yellow-brown pilose below* especially on midrib and veins, apical ones largest; *lateral leaflets 2 or 3 on each side of rachis*, opposite or subopposite; *blades elliptical to obovate*, 15–30 × 6–12 cm, base gradually acute, more or less symmetrical, apex acuminate; midrib stout; lateral veins 10–15 on each side of midrib, obtuse arcuate, inarched only near

margin and scarcely anastomosing, depressed above and prominent below when dry; petiolules 3–5 mm long, stout, densely tawny-tomentose. **Inflorescences** *spicate*, 1.5–7.5 cm long, supra-axillary on leafy or leafless twigs; rachis *c.* 4 mm diameter, sericeous, woody. **Flowers** [only known in bud; description largely from King, *op. cit.*] sweetly scented; *calyx* 4-toothed, broadly ovate, densely appressed pubescent outside, apices subacute; *petals* 4, waxy; staminal tube glabrous, margin 8-emarginate, *anthers* 8, oblong, exserted; disc very small; style pilose basally, stylehead discoid, dimpled. **Fruits** *pear-shaped*, at least 3×2 cm, apiculate, densely tomentose, orange-red, 3- or 4-valved. **Seeds** 2–4; testa brown.

Distribution. Peninsular Thailand, Peninsular Malaysia and Borneo. In Borneo rare, known only by a single collection (*S 40015*) from Long Jakah, Belaga district, Sarawak.

Ecology. Rain forest, at altitude *c.* 550 m.

Notes. This is a very poorly known plant having the habit and facies of *Dysoxylum rugulosum* King and its allies, with which it shares a spicate inflorescence and 4-merous flowers but lacks the stiletto-like apical buds typical of that group.

19. *Dysoxylum parasiticum* (Osbeck) Kosterm.

(Latin, *parasiticus* = parasitic; referring to the mistaken notion that the cauline inflorescence was a parasite on a tree of another species)

Sect. *Dysoxylum*

Reinwardtia 7, 3 (1966) 247; Backer & Bakhuizen *f.*, FJ 3 (1968) 654; Whitmore, Tantra & Sutisna *op. cit.* 232; Mabberley *et al. op. cit.* 76; PROSEA 5, 3 (1998) 202. **Basionym:** *Melia parasitica* Osbeck, Dagb. Ostind. Resa (1757) 278. **Type:** *Osbeck s.n.*, Java [P. Peutjang, 20 Jan 1752] (holotype S [photo FHO, K], *n.v.*, [fragm. BO, *n.v.*]; isotype LINN). **Synonyms:** *Piptosaccos hypophyllantha* Turcz. *op. cit.* 415; *Dysoxylum ramiflorum* Miq. *op. cit.* (1868) 10, *nom. illeg.*

Tree, 20–27(–36) m tall, somewhat pachycaul, sometimes flowering as an unbranched or sparsely branched treelet; bole to 45(–60) cm diameter; buttresses to 1.5 m tall and out, concave, when present then bole fluted. **Bark** smooth, yellowish, with scattered pustular lenticels to flaking, grey-brown with inflorescence bosses to 8×8 cm; inner bark pale brown with orange streaks. **Sapwood** white; heartwood red. **Twigs** suberect, brownish to pinkish grey with brown lenticels and conspicuous scutellar (= platter-shaped) petiole scars, 5–12 mm diameter apically, pithy, more or less fulvous-pubescent to tomentose. **Apical buds** with *fist-shaped* young leaves, more or less fulvous-tomentose. **Leaves** *spirally arranged*, bunched at twig apices, 100–150 cm long when mature, *imparipinnate*, the apical portion developing throughout a season and the terminal leaflet sometimes undeveloped or lost; petioles 8–12 cm long, 3–7 mm diameter, terete, swollen and flattened to grooved adaxially at base, more or less pubescent, lenticellate; leaflets dull dark green above, paler below, chartaceous when dry, subglabrous to densely fulvous-tomentose below and on veins above; lateral leaflets 17(–19) on each side of rachis, opposite to subopposite, the largest the more apical; blades narrowly elliptical to oblong, to 19(–28) \times 6(–8) cm, the most proximal smallest, subelliptical to suborbicular, base obtuse to rounded, more or less asymmetrical, apex subacuminate; venation brochiodromous; lateral veins 15–20 on each side of midrib,

arcuate; intercostal venation conspicuously reticulate, prominent below; petiolules 3–8(–18 on terminal leaflet) mm long, more or less densely tomentose. **Inflorescences** *racemose*, to 30 cm long, pendent, *borne in fascicles on bosses on the bole, major branches and twigs*, and/or in axils, where usually solitary, sometimes few-flowered or even flowers solitary; rachis subglabrous to densely pilose or tomentose; bracts triangular, *c.* 1 mm long, rarely lanceolate, foliaceous, to 8 mm long. **Flowers** sweetly scented; pedicels 6–13 mm long, subglabrous to densely appressed pubescent; *calyx* cylindrical, *7–15 mm tall*, cream, subglabrous or with ciliate margin to densely appressed pubescent, *margin irregularly (2 or) 3–5-lobed*, lobes 4–6 mm long, triangular, reflexed at anthesis; *petals* 4 (or 5), linear-lanceolate, 15–20(–28) mm long, imbricate at apices, where thicker, white or creamish, more or less appressed pubescent outside especially apically; staminal tube glabrous or rarely sparsely hirtellous inside or outside, margin with 8 (rarely 10 or 12) lobes, truncate, emarginate or shallowly bifid, reflexed at anthesis, *anthers* 8 (rarely 10 or 12), oblong, *c.* 1.2 mm long, brown; disc cylindrical, 4–5 mm tall, glabrous, margin truncate to crenulate; *ovary* densely appressed pilose, *4(or 5)-locular*, each locule with 1 or 2 superposed ovules, style densely appressed pilose in proximal half, stylehead subcapitate to discoid. **Infructescences** to 30 cm long or fruits solitary. **Fruits** obovoid-globose to depressed globose, to 4 cm diameter, conspicuously 4- or 5-ribbed, red-brown, dehiscing starwise; carpels white inside. **Seeds** 2–5, *c.* 2 cm long, brownish black with basal orange-red aril.

Vernacular name. Sabah—*jarum-jarum* (Bajau).

Distribution. Taiwan (Lan Yü), Sumatra, Java, Borneo, the Philippines, Sulawesi, Nusa Tenggara, Maluku, New Guinea, Bismarck Archipelago, Solomon Islands and NE Australia. In Borneo, known only in Sabah from Kinabatangan, Lahad Datu, Ranau and Semporna districts (e.g., *SAN* 26339, *SAN* 77181, *SAN* 87951, *SAN* 117116, *SAN* 134808 and *SAN* 143610) and in Kalimantan (e.g., *de Vogel* 911).

Ecology. Rain forest, including that on limestone, at altitudes to 2100 m. Flowers pollinated by butterflies.

20. *Dysoxylum rigidum* (Ridl.) Mabb.

(Latin, *rigidus* = rigid; probably referring to the leaflets)

Sect. *Dysoxylum*

Mal. For. 45 (1982) 450, *op. cit.* (1989) 245; Whitmore, Tantra & Sutisna *op. cit.* 232; Mabblerley *et al. op. cit.* 105; Turner *op. cit.* 341; PROSEA 5, 3 (1998) 202. **Basionym:** *Chisocheton rigidus* Ridl., Bull. Misc. Inform. Kew (1929) 122. **Lectotype** (Mabblerley, 1982): *Hamid KEP 10880*, Peninsular Malaysia, Pahang, Temerloh, Kemasul FR (K; isoelectotypes E, SING).

Tree to 30 m tall; bole to 60 cm diameter; buttresses to 2.5 m tall and 50 cm out. **Bark** smooth and lenticellate to cracking, reddish grey; inner bark pale yellow to red- or brown-mottled, *slash onion-scented*. **Sapwood** creamy-yellow. **Twigs** *c.* 5 mm diameter apically, with distinct petiole scars. **Apical buds** *with tomentose fist-shaped young leaves*. **Leaves** *spirally arranged*, 25–55 cm long, *with apical scar, one of the lateral leaflets often appearing terminal*; petioles 10–13 cm long, *c.* 3.5 mm diameter, conspicuously swollen at base, drying rather blackish like the rachis and petiolules; *leaflets* coriaceous, *glabrous*; lateral leaflets 4 or 5 on each side of rachis; blades broadly elliptical-ovate or weakly

obovate, 15–20(–28) × 5–8(–17) cm, base cuneate to obtuse, somewhat asymmetrical, apex acuminate; venation brochiodromous; lateral veins (7–)9–11 on each side of midrib, prominent below, sunken above; *intercostal venation conspicuously scalariform*; petiolules 0.5–1.2 cm long, swollen. **Inflorescences** to 23 cm long, axillary (sometimes in axils of undeveloped leaves); axes finely appressed fawn-pubescent; *branches to 16 cm long*; bracts lanceolate, 2–6 mm long, fawn-pubescent. **Flowers:** *calyx* c. 6 mm diameter, with 3 or 4 ovate lobes c. 4 mm long, acute, pubescent; *petals* 5, oblong, 5–8 mm long, obtuse, attached to staminal tube at base, finely pubescent outside; staminal tube pubescent inside, margin subentire, *anthers* 10, narrowly oblong, c. 1 mm long, glabrous; disc cup-shaped, c. 1 mm tall, fleshy, densely pilose; *ovary* (?) 5-locular. **Fruits** depressed globose, at least 2.8 cm diameter, sparsely pubescent near sutures, pink to purplish brown. **Seeds** with bright red testa.

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known only in Sabah from Kinabatangan, Lahad Datu and Ranau districts (e.g., *SAN 16891*, *SAN 99296*, *SAN 141895* and *SAN 141896*) and in Kalimantan (e.g., *bb. 20730*).

Ecology. Lowland rain forest at altitudes to 260 m. Very rarely collected.

Notes. The strong onion scent of the slash is also found in some *Dysoxylum alliaceum* trees, as well as *D. magnificum* and *D. mollissimum*. The venation is reminiscent of that of *Aglaia oligophylla*, *Chisocheton lansiifolius* and *Lansium domesticum*.

21. *Dysoxylum rugulosum* King

(Latin, *rugulosus* = slightly wrinkled; referring to the surface of the dry leaflets)

Sect. *Cyrtochiton*

J. As. Soc. Beng. 64, 1 (1895) 49; Ridley *op. cit.* (1922) 397; Mabberley *op. cit.* (1989) 245; Whitmore, Tantra & Sutisna *op. cit.* 232; Mabberley *et al. op. cit.* 127; Turner *op. cit.* 341; Coode *et al.* (eds.) *op. cit.* 205; Beaman & Anderson *op. cit.* 132. **Lectotype** (selected here): *King's collector 3158*, Peninsular Malaysia, Perak, Larut (SING; isoelectotypes BM, K, UC, Z). **Synonyms:** *Dysoxylum undulatum* Hend., Gard. Bull. Str. Settl. 7 (1933) 90, Anderson *op. cit.* (1980) 252; *Dysoxylum fulvum* Airy Shaw, Bull. Misc. Inform. Kew (1940) 255.

Small tree to 20 m tall; bole to 20 cm diameter, flowering when a sapling. **Bark** smooth, brown, to finely fissured and scaling; inner bark yellow-brown, mottled. **Sapwood** cream. **Twigs** striate, with conspicuous petiole scars, 4–6 mm diameter apically, fulvous-tomentellous when young. **Apical buds** *stiletto-shaped*. **Leaves** *spirally arranged*, 20–40 cm long, *strictly paripinnate, with a terminal pair of leaflets with a scar between them or one leaflet and a spike or its scar*; *petioles* 6–15 cm long, more or less finely puberulous, flattened adaxially, conspicuously swollen at base; *leaflets* chartaceous to subcoriaceous, *glabrous or subglabrous below*, rugulose, minutely black gland-dotted, (1 or) 2–4 (or 5) on each side of rachis, alternate to subopposite; blades oblong-lanceolate, 10–27 × 2.5–8 cm, the most distal the largest, base acute, attenuate, apex abruptly acuminate; *lateral veins* 8–14 on each side of midrib, sometimes with domatia in axils, arcuate, *prominent below*; *intercostal venation obscure*; petiolules 4–10 mm long, swollen, blackish when dry. **Inflorescences** thyrsoid or spicate, 1–8 cm long, *supra-axillary*; rachis 2–3 mm diameter, puberulous, bearing congested cymes of 3 or 4 flowers; bracts triangular, c. 1 mm. **Flowers** sweetly scented; *calyx* very shallowly cup-shaped, c. 2 × 5 mm, puberulous outside, *shortly 4-toothed*; *petals* 4, elliptical, c. 8 × 3 mm, puberulous outside, yellowish,

valvate; *staminal tube* more or less 4-angled, glabrous or sparsely puberulous on angles outside, *margin crenate to (7 or)8(or 9)-toothed*, the teeth emarginate, *anthers (7 or) 8 (or 9)*, elliptical, *c.* 1 mm long, included; disc *c.* 2 mm tall and diameter, fleshy, glabrous or somewhat pubescent inside, margin irregularly toothed; *ovary* pubescent, *4-locular*, style puberulent in proximal half, stylehead discoid with basal annulus. **Fruits** solitary or paired, 3–5 × 2–2.5 cm, deeply 3- or 4-lobed, glabrous and orange when mature, blackish when dry, veined. **Seeds** black.

Vernacular names. Sabah—*lisi-lisi* (Dusun Kalabakan). Sarawak—*segera* (Iban).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, recorded in Sabah from Beaufort, Keningau, Labuk Sugut, Lahad Datu, Penampang, Ranau, Tambunan and Tenom districts (e.g., *SAN 27459*, *SAN 31883*, *SAN 94947*, *SAN 110566* and *SAN 124767*) and in Sarawak from Kapit, Kuching, Lawas, Limbang, Lundu, Miri, Sri Aman and Tatau districts (e.g., *S 21872*, *S 36892*, *S 41290*, *S 52580* and *S 69745*). Also occurring in Brunei (e.g., *Coode et al. 7270*) and E Kalimantan.

Ecology. Lowland, hill and montane rainforests at altitudes to 2050 m. Plants are not infrequently attacked resulting in leaf damage like that recorded for *Dysoxylum brachybotrys* while the ovaries are sometimes abnormally large through their being occupied by larvae.

Notes. *Dysoxylum brachybotrys* may merely be a rather distinct form of this species. There are other forms with particularly large leaflets and fruits with very short stipes (e.g., *S 21872* and *S 41290*). There is extremely little flowering material of this species, which, like the closely allied *D. cyrtobotryum* complex (to which sheets from the Bornean uplands cited by Mabberley *et al. op. cit.* 127 [Note] are here referred), needs analysis in the field: a number of distinct taxa may be involved.

Incompletely known species

Dysoxylum sp. 3.

Mabberley *et al.*, FM 1, 12 (1995) 133.

A treelet to 3 m tall, of weeping habit with grey twigs. Leaves with 2 or 3 narrow, glabrous leaflets on each side of rachis. Fruits solitary, orange, containing 4 black seeds with orange arils. Flowers unknown.

Distribution. Borneo and the Philippines. In Borneo, known only in Sabah from Kinabatangan, Lahad Datu, Sandakan and Tawau districts (e.g., *Mabberley 1694*, *SAN 24476*, *SAN 51910*, *SAN 117633* and *Sugau 312*) and in Brunei (e.g., *Dransfield JD 7239*).

Notes. This taxon approaches some of the small trees discussed under *D. cyrtobotryum*.

7. HEYNEA Roxb.

(Benjamin Heyne (1770–1819), German Moravian Missionary, superintendent of Bangalore Gardens, India)

Bot. Mag. 41 (1815) *t.* 1738; Hiern *in* Hooker *f.*, Fl. Brit. Ind. 1 (1875) 565; King, J. As. Soc. Beng. 64, 1 (1895) 86; Ridley, FMP 1 (1922) 413; Merrill, Enum. Philip. Pl. 2 (1923) 380; Mabberley *et al.*, FM 1, 12 (1995) 41; Coode *et al.* (eds.), CLBD (1996) 206; Mabberley, PB 2nd. ed. (1997) 340; Beaman & Anderson, PMK 5 (2004) 132. **Synonyms:** *Walsura* Roxb. sect. *Heynea* (Roxb.) Harms *in* Engler & Prantl, Nat. Pflanzenfam. 1, 3 (4) (1896) 30, *nom. illeg.*; *Trichilia sensu auctt. non L.*: Benth., Acta Bot. Neerl. 11 (1862) 11, *p.p.*, Pennington & Styles, Blumea 22 (1975) 467, *p.p.*, Mabberley *in* Mabberley & Pannell, TFM 4 (1989) 251, *p.p.*

Trees. **Indumentum** of simple hairs. **Bud scales** absent. **Leaves** spirally arranged, *imparipinnate*, without *pseudogemmula*; *rachis* compressed, *not swollen at points of attachment of leaflets*; lower surface of leaflets papillate, glandular. **Inflorescences** corymbose-cymes with long peduncles. **Flowers** unisexual (plants dioecious) or bisexual; calyx 4- or 5-lobed, the lobes imbricate; *petals* 4 or 5, aestivation more or less imbricate; *androecium* with cylindrical staminal tube to 1/3 its length with 8 or 10 filaments with bifid apices; *disc* annular; ovary 2- or 3-locular, each locule with 2 ovules, stylehead 2- or 3-lobed. **Fruits** capsular; pericarp with sclereids. **Seeds** 1 or 2, pre-*raphe-funicular-arillate*.

Distribution. Two species, *H. trijuga* and *H. velutina* How & Chen in E and SE Asia. Of these, only *H. trijuga* is found in Sabah and Sarawak.

Notes. Apparently very close to *Walsura* with which it has been combined in the past. The generic and specific descriptions used by Sims in Bot. Mag. (*op. cit.*) were taken directly from the manuscript of Roxburgh's *Plants of the Coast of Coromandel*, which is cited there, and are therefore attributable to Roxburgh.

Heynea trijuga Roxb.

Fig. 24.

(Latin, *tri* = three, *jugum* = yoke; referring to leaves with three pairs of leaflets)

Bot. Mag. 41 (1815) *t.* 1738, Pl. Corom. 3 (1820) 56, *t.* 260; Hiern *op. cit.* 565; King *op. cit.* 86; Ridley *op. cit.* (1922) 413; Mabberley *et al. op. cit.* 41; Turner, Gard. Bull. Sing. 47 (1995) 342; Coode *et al.* (eds.) *op. cit.* 206; Beaman & Anderson *op. cit.* 132. **Lectotype** (selected here): Cultivated (from seeds coll. *Buchanan-Hamilton*, Nepal 1802), India, HEIC Garden, Calcutta, *c.* 1808/9, *Icones Roxburghianae 1843* (K). **Synonyms:** *Heynea sumatrana* Miq., Fl. Ind. Bat. Suppl. (1861) 197, 505, Merrill *op. cit.* (1921) 323, *op. cit.* (1923) 380, Masamune *op. cit.* 376; *Walsura trijuga* (Roxb.) Kurz, J. As. Soc. Beng. 44, 2 (1875) 148; *Walsura sumatrana* (Miq.) Koord., Exkurs. Fl. Java 2 (1912) 447, Merrill, EB (1921) 323, Masamune, EPB (1942) 376. (For further synonymy cf. Mabberley *et al. op. cit.*)

Small tree to 15 m tall; bole to 20 cm diameter but usually much smaller. **Bark** dark brown, lenticellate to grey and weakly cracking into irregular rectangles; inner bark whitish. **Twigs** (young) very dark brown to blackish, lenticellate, 4–7 mm diameter apically. All foliage and inflorescences in current flush. **Leaves** to 50 cm long; petioles 5–15 cm long, terete; leaflets articulated at petiolule apices, upper surface glabrous, shining, lower surface glabrous to hairy, glaucous; lateral leaflets 5 (or 6) on each side of rachis, opposite; blades ovate-oblong, 4.5–20 × 2–7.5 cm, base asymmetrical, rounded to acute, apex acuminate; lateral veins 5–8 on each side of midrib, looping together but not reaching margin. **Inflorescences**

foamy subcorymbose cymes, to 50 cm across, axillary; peduncles over half as long, with 3–7 pairs of decussate branches, each with 1–3 (or 4) orders of branchlets; bracts small, caducous. **Flowers** scented; pedicels 1.5–2 mm long, each with 2 small persistent bracteoles; calyx *c.* 1 mm tall, pale pink, lobes broadly triangular, apices rounded to acuminate, often hairy outside, margin sometimes ciliate; petals oblong, 0.7–1 mm wide, acute, often hairy outside, white to pink or cream, margin sometimes ciliate; stamens 8 or 10(–14), alternately long and short, strigose inside, sometimes puberulous outside, pink, anthers ovate, *c.* 1 mm long, apiculate, subglabrous, bright yellow, inserted between 2 linear acute glabrous teeth; disc fleshy; ovary glabrous. **Fruits** globose, 1–2 cm diameter, pink. **Seed** 1, ovoid, almost covered in a white aril, dangling from long funicle; testa dark brown.

Vernacular names. Sabah—*langitan* (Kedayan), *linkas* (Dusun Kinabatangan), *merbau lalat* (Malay), *takalis* (Ranau). Sarawak—*buah pasat* (Iban), *segera* (Iban).

Distribution. S India to S China, Sumatra, Peninsular Malaysia, Borneo and the Philippines. In Borneo, known in Sabah from Keningau, Kinabatangan, Kota Belud, Kota Marudu, Kuala Penyu, Kudat, Lahad Datu, Papar, Penampang, Pitas, Ranau, Sandakan, Semporna, Tambunan, Tawau, Tenom and Tuaran districts (e.g., *Pennington* 7927, *SAN* 32172, *SAN* 76481, *SAN* 84024 and *SAN* 127288) and in Sarawak from Belaga, Bintulu, Kapit, Lawas and Miri districts (e.g., *S* 21892, *S* 38399, *S* 40946, *S* 52306 and *Zainudin* AZ 5596). Also occurring in Brunei (e.g., *BRUN* 5734) and Kalimantan (e.g., *Kostermans* 9885).

Ecology. Rain forest, especially at the edge and in regenerating clearings, and along roadsides, at altitudes to 1250 m.

Uses. Long cultivated in Java (and Europe, under glass-house), this is a handsome tree suitable for town gardens. The leaves and bark are bitter and of medicinal value.

8. LANSIUM Corrêa

(from the Malay name, *langsar*)

Ann. Mus. Hist. Nat. Paris 10 (1807) 157; Hiern *in* Hooker *f.*, Fl. Brit. Ind. 1 (1875) 558, *p.p.*; King, J. As. Soc. Beng. 64, 1 (1895) 80, *p.p.*; Ridley, FMP 1 (1922) 410, *p.p.*; Backer & Bakhuizen *f.*, FJ 2 (1965) 125; Pennington & Styles, Blumea 22 (1975) 483; Mabberley, Blumea 31 (1985) 140, *in* Mabberley & Pannell, TFM 4 (1989) 246, PB 2nd. ed. (1997) 390; Corner, WSTM 3rd. ed., 2 (1988) 501, *p.p.*; Mabberley *et al.*, FM 1, 12 (1995) 314; Argent *et al.* (eds.), MNDR-CK 2 (1997) 419. **Synonym:** *Aglaia* Lour. sect. *Lansium* (Corrêa) Kosterm., Reinwardtia 7, 3 (1966) 221, *nom. illeg.* (*nom. superfl. pro* sect. *Neolansium* Harms), *p.p.*

Trees. **Indumentum** of simple hairs. **Bud scales** absent. **Leaves** spirally arranged, *paripinnate*, without *pseudogemmula*; leaflets subopposite to alternate, *the most distal on one side appearing terminal*; petiolules pulvinate at base. **Inflorescences** spikes, racemes or more rarely basally branched panicles with spicate or racemose branches, *borne on twigs, branches or bole*. **Flowers** unisexual (tree dioecious) or bisexual; female and bisexual flowers larger than male ones; calyx deeply 5-lobed, the lobes imbricate; petals 5, free from each other but united with staminal tube in proximal third to half, aestivation imbricate; staminal tube globose to cyathiform (= cup-shaped), margin more or less undulate, *anthers* (8–)10 in one whorl inside the throat of the staminal tube, their tips not or slightly exerted,

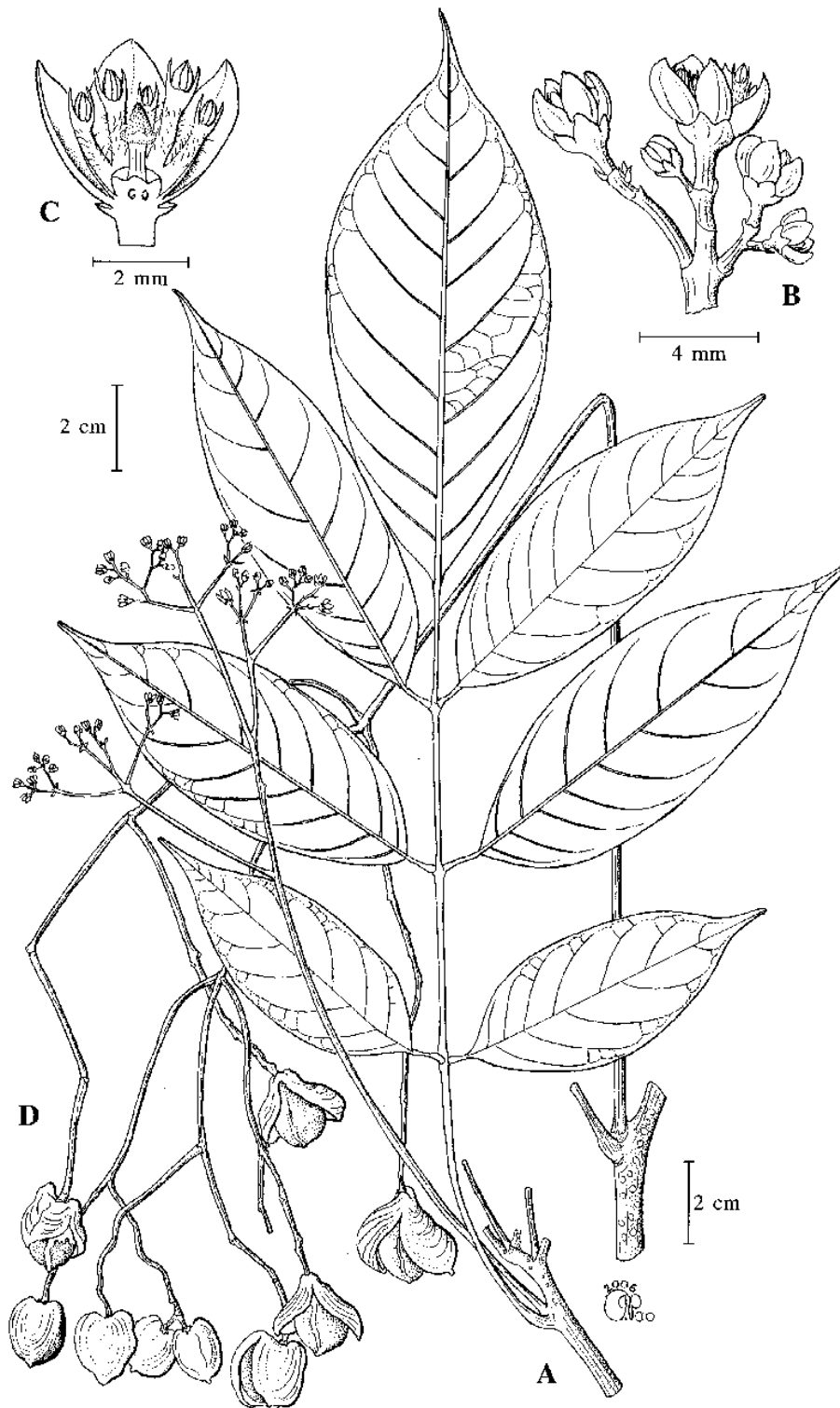


Fig. 24. *Heynea trijuga*. A, flowering leafy twig; B, distal part of inflorescence; C, longitudinal section of flower; D, infructescence. (A–C from *Forman* 2700, D from *S* 38399.)

without appendages; *disc absent*; ovary 3–5-locular, each locule with one ovule, style long and broad-columnar, its flanks ribbed with the impressions of the surrounding anthers, *stigma unlobed*. **Fruit** a 1–5-seeded berry. **Seeds** usually arillate; aril completely enveloping seed; embryo with thick planoconvex, superposed free cotyledons; radicle included. Germination cryptocotylar; eophylls simple, opposite.

Distribution. Three species, the genus possibly being the only one restricted to Malesia, but planting of *Lansium domesticum*, which may be native in southern Thailand in any case, elsewhere has obscured this. In Borneo, only *L. domesticum* is found; the other two, *L. membranaceum* (Kosterm.) Mabb. and *L. brevircemosum* Kosterm. occur only in Sumatra and the Lesser Sunda Islands (Sumbawa and Flores), respectively.

Ecology. Rain forest, including *kerangas*, at altitudes to 1360 m.

Notes. The venation of the leaflets closely resembles that of many Sapindaceae, notably *Lepisanthes* spp. and is also seen in *Aglaia* spp., particularly *A. oligophylla*, *Chisocheton lansiifolius* and *Dysoxylum rigidum*.

Lansium domesticum Corrêa
(Latin, *domesticus* = cultivated)

Fig. 25, Plate 6C.

Ann. Mus. Hist. Nat. Paris 10 (1807) 157; Hiern *op. cit.* 558; King *op. cit.* 81; Merrill, EB (1921) 320, Enum. Philip. Pl. 2 (1923) 368, PEB (1929) 123; Ridley *op. cit.* (1922) 411; Masamune, EPB (1942) 376; Backer & Bakhuizen *f. op. cit.* (1965) 125; Mabberley, Blumea 31 (1985) 141, *op. cit.* (1989) 246; Corner *op. cit.* (1988) 501; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 233; Mabberley *et al. op. cit.* 315; PROSEA 2 (1991) 186; Turner, Gard. Bull. Sing. 47 (1995) 342; Coode *et al.* (eds.) *op. cit.* 206; Argent *et al.* (eds.) *op. cit.* 420; Beaman & Anderson *op. cit.* 132. **Neotype** (Kostermans, 1966): *Kostermans s.n.*, cult. Java (BO). **Synonyms:** *Lansium domesticum* Corrêa var. *aqueum* Jack, Trans. Linn. Soc., London 14, 1 (1823) 116; *Lansium aqueum* (Jack) M.J.Roem., Fam. Nat. Syn. Monogr. 1 (1846) 99; *Aglaia aquea* (Jack) Kosterm. *op. cit.* (1966) 234; *Aglaia dookoo* Griff., Not. 4 (1854) 505, Kostermans *op. cit.* (1966) 238; *Aglaia domestica* (Corrêa) Pellegr., Fl. Gén. Indoch. 1 (1911) 766, *nom. illeg.*, Kostermans *op. cit.* (1966) 244. (For complete synonymy *cf.* Mabberley *op. cit.*, 1985.)

Tree to 30 m tall and 75 cm diameter but usually much less; bole irregularly fluted; buttresses short, concave, to 2 m out. **Bark** light reddish brown or fawn mottled, slightly scaling and with tubercles of old infructescences. **Twigs** subglabrous to subtomentellous when young. **Leaves** 30–50 cm long; petioles 5–8 cm long, often flattened adaxially, pulvinate; leaflets coriaceous, glabrous above, subglabrous to fawn-tomentose below, especially on venation, 2–4 (or 5) on each side of rachis, alternate or subopposite; blades elliptical-ovate to oblong, 9–25(–45) × 5–10(–15) cm, the most apical usually the largest, base somewhat asymmetrical, acute to cuneate, apex shortly acuminate, acumen 10–15(–25) mm long; lateral veins (7–)10–14 on each side of midrib, arcuate; intercostal venation reticulate to scalariform, conspicuous on both surfaces when dry; petiolules 5–10 mm long, more or less pubescent. **Inflorescences** racemose, 4–20 cm long, solitary or usually in fascicles of 2–10 on branches and bole, rarely on twigs, more or less pubescent; bracts ovate, *c.* 1 mm, acute. **Flowers** sweetly scented; pedicels 0–2 mm long; calyx lobes suborbicular, 1–2 mm across, margin ciliate; petals ovate to suborbicular, 2–3 mm long, creamy-white; staminal tube glabrous or almost so, margin undulate to crenate, anthers 1–2 mm long, within or slightly protruding from staminal tube; ovary and style densely pilose.

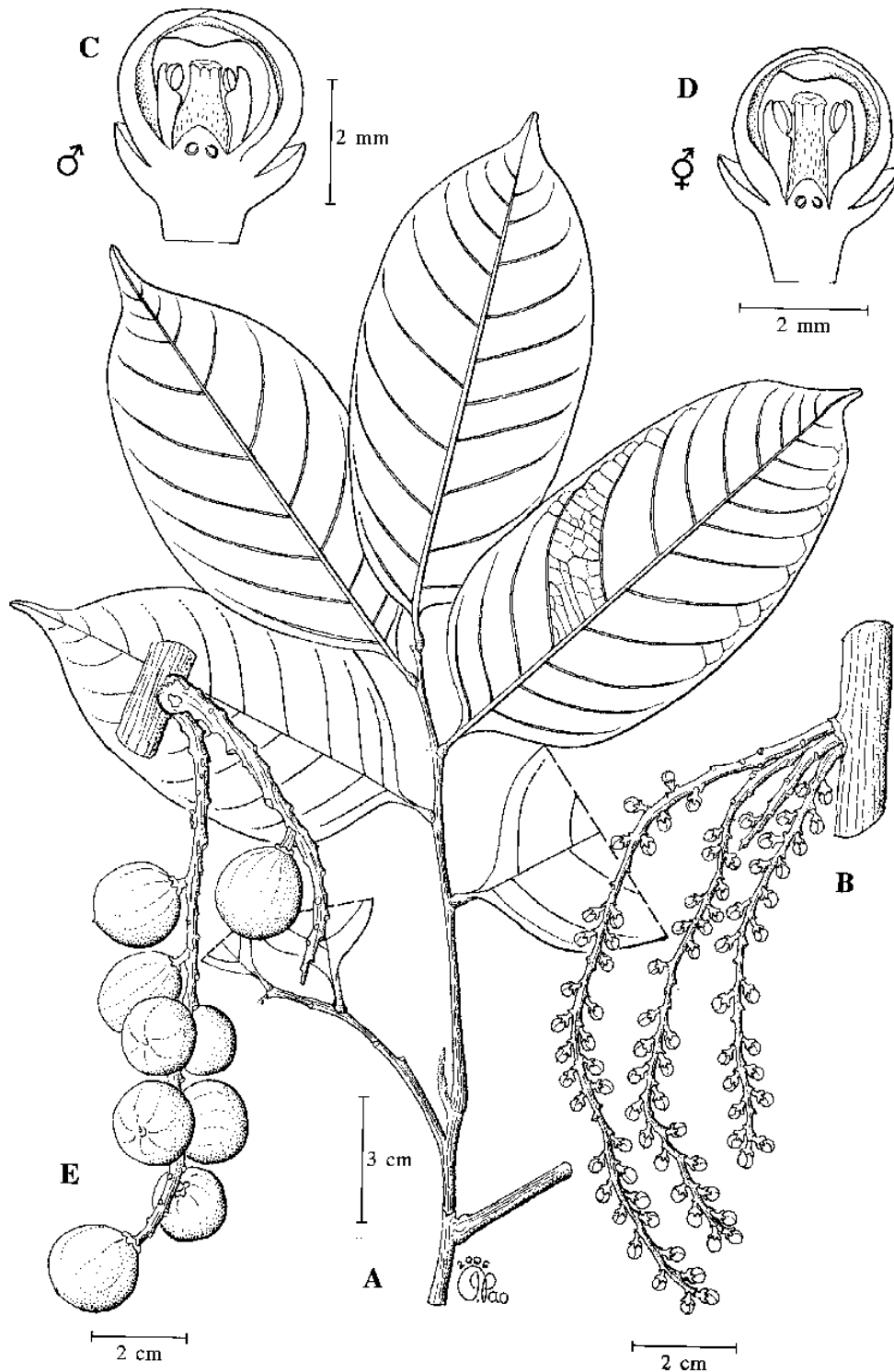


Fig. 25. *Lansium domesticum*. A, leafy twig; B, inflorescences; C, longitudinal section of male flower; D, longitudinal section of bisexual flower; E, infructescence. (A from S 49293, B–D from S 25711, E from SAN 21541.)

Fruits ellipsoid-globose, 2–4 × 1.5–2(–4) cm, pale yellow or brownish, often becoming glabrous; pericarp sometimes with white latex, white inside; the locules with undeveloped seeds filled with arillate tissue. **Seeds** 1–5, more or less flattened ellipsoid, *c.* 13 × 7 mm; aril completely enveloping seed, *c.* 25 × 15 mm, perichalazal and pachychalazal, developing from funicle and exostome. Seedlings with simple leaves.

Vernacular names. Known throughout Malaysia and Indonesia as *langsat*. Different cultivars are known locally as *duku*, *duku-langsat*, *kokosan* or *pisitan*.

Distribution. Peninsular Thailand; ‘wild’, cultivated and naturalized in Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi, Maluku and Irian Jaya (W New Guinea). In Borneo, known in Sabah from Beaufort, Kinabatangan, Kota Kinabalu, Kuala Penyu, Lahad Datu, Ranau, Sandakan and Tenom districts (e.g., *Pennington* 7885, *SAN* 21541, *SAN* 39451, *SAN* 126699 and *SAN* 134927) and in Sarawak from Bau, Belaga, Betong, Bintulu, Kapit, Kuching, Limbang, Lubok Antu, Lundu, Marudi, Miri, Simunjan and Sri Aman districts (e.g., *Mabberley* 1602, *S* 35639, *S* 48298, *S* 58182 and *S* 68673). Also occurring in Brunei (e.g., *BRUN* 16841) and Kalimantan (e.g., *Kostermans* 6223).

Ecology. Rain forest including *kerangas* and on limestone, at altitudes to 110 m. Fruits said to be dispersed by bats.

Uses. *Lansium domesticum* is one of the important native fruit trees of Malaysia but it is scarcely grown on a plantation scale. Most of the fruits seen in markets are harvested from village trees. Although refreshing, the arils have one of the lowest vitamin C contents of any fruit grown in Borneo. The fruits in Malay markets are called *duku* and *langsat* and, more recently has appeared the more appreciated *duku-langsat*. The name *duku* is used for a larger round form, which is borne in infructescences of about 8–12. The pericarp is always *c.* 5 mm thick without latex. Usually there are no developed seeds and the aril is sweetly flavoured. By contrast the *langsat* has smaller ellipsoid bitter-sweet fruits with thin pericarp and much latex, borne in infructescences of about 20 or more. The *duku-langsat* has features of both. The *duku* is a tree with a densely leafy wide crown, reminiscent of *rambai*; the *langsat* is more scruffy in appearance with a more open crown. The *duku* and *langsat* are apomictic, the different forms thus being clones, their cultivar status now confirmed by AFLP analysis (Kiew *et al.*, *Telopea* 10 (2003) 225). Wild trees in Peninsular Malaysia at least have sourer, smaller fruits with latex: they are not readily grown outside the forest. Trees are propagated by budding, cleft and side grafting and from seed, in which case they flower after about 15 years. Interesting details of trading the fruits and of folklore associated with them is provided by Kostermans (*op.cit.* (1966) 241) and information on production, propagation and planting as well as diseases and pests is given in PROSEA (*op.cit.* (1991) 186).

The wood is light-coloured and has been used for toolhandles, houseposts and rafters. Formerly, it was one of the woods used for ‘baja’, a teeth-blackening agent used by Malays. The bark is astringent and is of possible medical value, particularly in treating dysentery. An extract has been used as an arrow poison, for which the seeds, which are said to be anthelmintic, have also been used. The pericarp has been burnt as an insect repellent in Java and, like the bark, used dried or boiled and drunk in the treatment of stomach ache, diarrhoea and intestinal spasms, as well as tooth-ache, high blood pressure, measles, malaria and other fevers. (PROSEA *op. cit.* (1991) 186).

9. PSEUDOCLOUSENA T.Clark

(Greek, *pseudo* = false, *Clausena* (Rutaceae), to which genus the sole species was first referred)

Blumea 38 (1994) 291, in Mabberley *et al.*, FM 1, 12 (1995) 55; Beaman & Anderson, PMK 5 (2004) 133. **Synonym:** *Walsura* sect. *Neowalsura* Harms in Engler & Prantl, Nat. Pflanzenfam. ed. 2, 19b, 1 (1940) 119.

Trees. **Indumentum** of simple hairs. **Bud scales** absent. **Leaves** spirally arranged, imparipinnate, without pseudogemma; rachis not swollen at insertion of leaflets. **Inflorescences** thyrses of bisexual or male flowers. **Flowers:** calyx deeply 5-lobed; petals more than 4, free, aestivation imbricate; staminal tube more or less cylindrical, each filament linear with bifid apex; disc absent; ovary 4- or 5-locular, each locule with 1 ovule. **Fruit** a 1- or 2-seeded berry, asymmetrical, shortly beaked. **Seeds** ellipsoid, non-arillate, possibly pachychalazal.

Distribution. One variable species of rain forest, distributed from Indo-China to Irian Jaya.

Pseudoclausena chrysogyne (Miq.) T.Clark

Fig. 26.

(Greek, *chryso*- = gold-, *gyne* = woman; referring to the colour of the trichomes covering the ovary)

Blumea 38 (1994) 291, *op. cit.* (1995) 55; Turner, Gard. Bull. Sing. 47 (1995) 342; Beaman & Anderson, FMK 5 (2004) 133. **Basionym:** *Clausena chrysogyne* Miq., Fl. Ind. Bat., Suppl. (1861) 502. **Type:** *Teijsmann s.n.* [= HB 3805], Sumatra, Palembang (holotype L [Acc. No. 9082021006]; isotype U [Acc. No. 43005]). **Synonyms:** *Cipadessa borneensis* Miq., Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 6; *Walsura multijuga* King, J. As. Soc. Beng. 64, 1 (1895) 85, Ridley, FMP 1 (1922) 412, Bull. Misc. Inform., Kew (1930) 370, Merrill, Enum. Philip. Pl. 2 (1923) 379; *Walsura glabra* Merr., Phil. J. Sci. 13 (1918) 76, EB (1921) 323, Masamune, EPB (1942) 377; *Walsura borneensis* Merr., PEB (1929) 132, Masamune *op. cit.* 377; *Walsura hosei* Ridl. *op. cit.* (1930) 371; *Walsura velutina* Ridl., *op. cit.* (1930) 371; *Walsura chrysogyne* (Miq.) Bakhuijzen f., Blumea 16 (1968) 359, Anderson, CLTS (1980) 253, Mabberley in Mabberley & Pannell, TFM 4 (1989) 254, Coode *et al.* (eds.), CLBD (1996) 206; *Pseudoclausena chrysogyne* (Miq.) T.Clark forma *velutina* (Ridl.) T.Clark *op. cit.* (1994) 294.

Tree to 25 m tall; bole to 15 m tall, to 60 cm diameter. **Bark** c. 2 mm thick, pale brown to grey-brown; inner bark 2–4 mm thick, red-brown. **Sapwood** whitish with red or pink tinge. **Twigs** 1–3.5 mm diameter apically, glabrous or puberulous or velvety, sometimes sparsely lenticellate. **Leaves** 18–42 cm long; petioles 2.5–8.5 cm long, 0.8–2.1 mm thick, terete or slightly flattened adaxially, glabrous or puberulous or velvety; leaflets subcoriaceous, lateral ones (1–)2–4(–7) on each side of rachis; blades ovate, elliptical or lanceolate, that of lateral leaflets (5.3–)7.2–14(–18.5) × 2.3–5(–6.5) cm, of terminal leaflets (6.4–)7.2–16.5(–19.5) × 2.4–5(–6.8), and of basal leaflets 4–12.5 × 1.9–5.5 cm, base attenuate and slightly asymmetrical, apex shortly acuminate; midrib and lateral veins prominent below; lateral veins 6–10(–15) on each side of midrib; petiolules (of distal leaflets) c. 10 mm long, 0.4–0.9 mm thick. **Inflorescences** clustered around shoot apex or in the axils of fully expanded leaves, 1–6(–10) cm long, branched to second (or third) order. **Flowers:** buds cylindrical to barrel-shaped, 3–3.6 × 1.4–2.6 mm; calyx 1.5–1.8 mm tall, lobes 0.8–1.2 mm long with a

blunt apex; petals 5, free or imbricate, narrowly elliptical-oblong, $2.8\text{--}4.8 \times 1.5\text{--}1.8$ mm; staminal tube 1.5–3.3 mm tall, 0.9–1.8 mm diameter, tubular for 1/4–1/2 of its length, anthers 0.4–0.5 mm long, glabrous or with a short tuft of trichomes at apex; ovary densely pubescent with short stiff hairs, each locule with one ovule, style more or less cylindrical, 0.4–0.6 mm long, 0.2–0.3 diameter, stigma subcapitate and shallowly 2-lobed on top. **Fruits** subglobose, 1.3–1.8 cm diameter with a short, asymmetrically positioned beak 3–5 mm long. **Seeds** subellipsoid, 0.8–1.3 cm long, dark brown and shining but lacking an aril.

Vernacular name. Sarawak—*bunya* (Iban).

Distribution. Indo-China, Sumatra, Peninsular Malaysia, Borneo, the Philippines, Sulawesi, Maluku and Irian Jaya. In Borneo, recorded in Sabah from Keningau, Labuk Sugut, Sandakan and Tawau districts (e.g., *Pennington* 7899, *SAN* 16479, *SAN* 66696, *SAN* 84007 and *SAN* 107255) and in Sarawak from Bintulu, Kapit, Limbang, Lundu, Marudi and Miri districts (e.g., *Pennington* 7983, *S* 24268, *S* 24459, *S* 32163 and *S* 77219). Also occurring in Brunei (e.g., *Awong Kaya* 20) and Kalimantan (e.g., *Ambriansyah et al.* 1302).

Notes. Specimens with young parts velutinous have been recognised as forma *velutina*. Although restricted to Borneo and the Philippines (Mindanao), its occurrence is sporadic and there are intermediate less hairy forms (see *Dysoxylum cauliformum* and *Toona* spp. for similar examples).

10. REINWARDTIODENDRON Koord.

(Caspar Georg Carl Reinwardt, 1773–1854, sometime Director of the Botanic Gardens at Bogor, Java; Greek, *dendron* = tree)

Meded. s'Lands Pl. Buitenz. 19 (1898) 389; Merrill, Enum. Philip. Pl. 2 (1923) 369; Pennington & Styles, Blumea 22 (1975) 486; Mabberley, Blumea 31 (1985) 144, in Mabberley & Pannell, TFM 4 (1989) 247, PB 2nd. ed. (1997) 609; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 233; Mabberley *et al.*, FM 1, 12 (1995) 322; Argent *et al.* (eds.), MNDR-CK 2 (1997) 420; PROSEA 5, 3 (1998) 490; Beaman & Anderson, PMK 5 (2004) 133. **Synonyms:** *Lansium* Corrêa sect. *Neolansium* Harms in Engler & Prantl, Nat. Pflanzenfam. ed. 2, 19b (1940) 124; *Aglaia* Lour. sect. *Lansium* (Corrêa) Kosterm., Reinwardtia 7, 3 (1966) 221, *nom. illeg.*, p.p.

Trees. **Indumentum** of simple hairs. **Bud scales** absent. **Leaves** spirally arranged, without pseudogemma, pinnate or trifoliate; leaflets alternate, the most distal on one side appearing terminal; petiolules often swollen; domatia frequently present. **Inflorescences** axillary spikes or basally branched panicles of spikes. **Flowers** bisexual, yellow; calyx deeply 5-lobed, lobes orbicular, imbricate; petals 5, free from each other but united with staminal tube at base; staminal tube globose to ovoid, with an undulate to toothed margin, anthers 10 in 2 whorls of 5, glabrous, the upper ones partly exserted, the lower ones alternating with the upper ones and completely included, their connectives extended to form a short acute appendage; *disc absent*; ovary 5-locular, each locule with one ovule, style very short, with a small capitate (= head-shaped) or pileate (= cap-shaped), obscurely lobed apex. **Fruit** a 1–5-seeded berry. **Seeds** apparently sarcotestal; embryo with thick planoconvex, superposed, free cotyledons; radicle included.

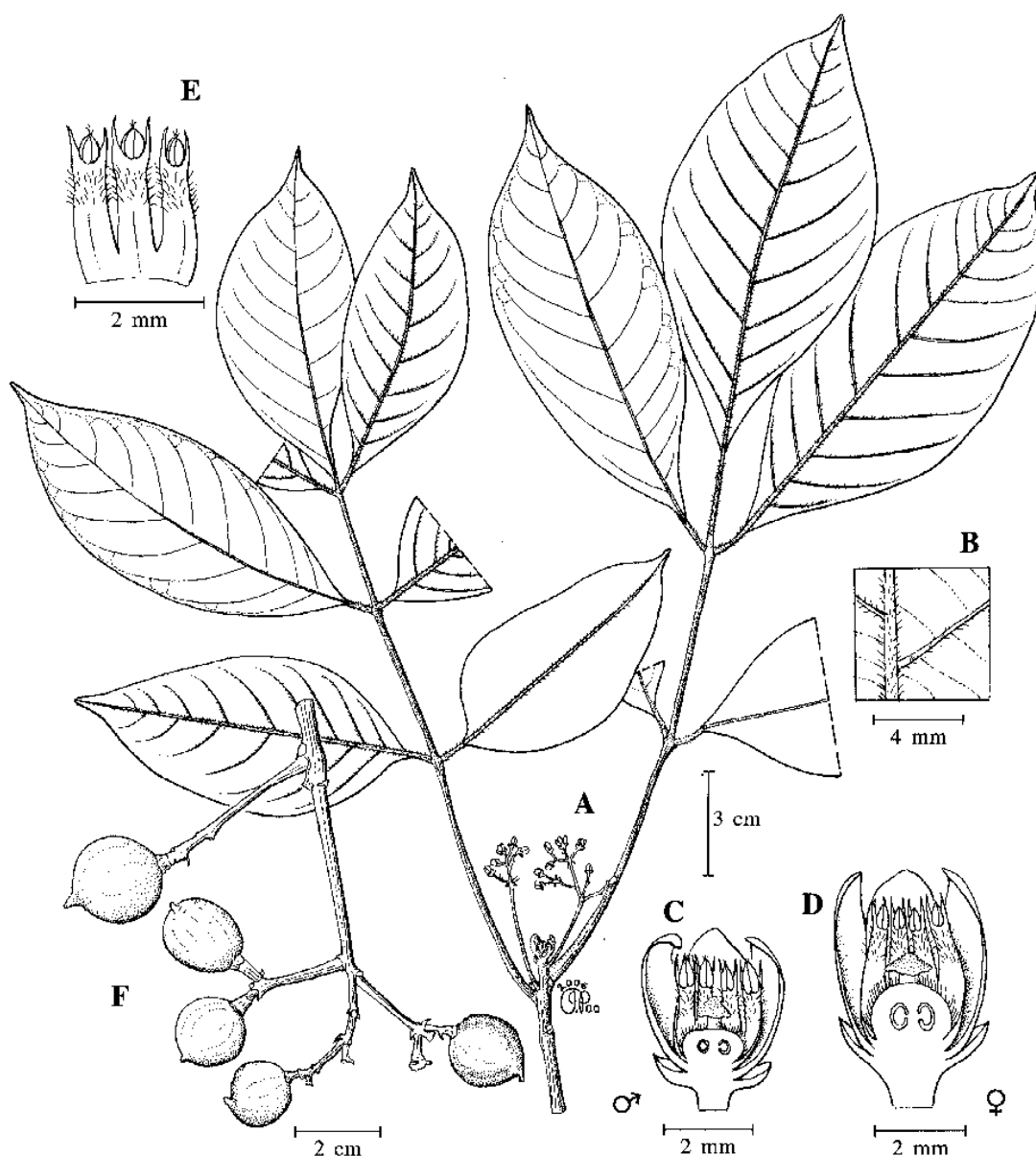


Fig. 26. *Pseudoclausena chrysogyne*. A, flowering leafy twig; B, detail of part of lower leaf surface showing fine venation and indumentum; C, longitudinal section of male flower; D, longitudinal section of female flower; E, adaxial view of stamens; F, infructescence. (A–E from SAN 119062, F from ITTO/BA 1055.)

Distribution. Probably seven species restricted to Indo-Malesia, from the W Ghats of India (*R. anaimalaiense* (Bedd.) Mabb.) to Irian Jaya. Of these, three species occur in Sabah and Sarawak.

Ecology. Rain forest at altitudes to about 900 m.

Uses. The wood of *Reinwardtiidendron* is used for making high grade furniture, panels, doors and window frames.

Notes. The genus consists of very closely related but clearcut, distinct species, some of which are very little known. It closely resembles *Aglaia* in pollen and secondary xylem as well as overall facies but it differs in its simple indumentum, the two whorls of anthers with appendages and the 5-locular ovary. It is perhaps closest to *Lansium* that shares the indumentum type and the leaflet form and venation but the latter differs in its single whorl of 10 stamens without appendages, the inflorescences borne on branches and bole and the seeds, which are arillate and pachychalazal.

Key to *Reinwardtiidendron* species

1. Secondary lateral veins of leaflets almost as prominent as the primary ones, at least on upper surface.....**2. R. humile**
Secondary lateral veins of leaflets not so prominent.....2
2. Petiole densely and lower surface of leaflet sparsely brown-tomentose. Leaflets 2–4 (or 5) on each side of rachis; blades elliptical, 4–5.5(–8) × 1.5–2.5(–3.5) cm, acumen 6–8 mm long. Fruits glabrous, globose, to 2 cm diameter.....**1. R. cinereum**
Petiole sparsely pubescent to glabrous, lower surface of leaflet glabrous. Leaflets 1 or 2 on each side of rachis; blades oblong-elliptical, 8–15 × 3–6.5 cm, acumen to 18 mm long. Fruits sericeous, depressed globose to obovoid with apical depression and 5 ribs, to 5 cm diameter.....**3. R. kinabaluense**

1. *Reinwardtiidendron cinereum* (Hiern) Mabb.

(Latin, *cinereus* = ashen; referring to the colour of dried leaves)

Mal. For. 45 (1982) 452, *op. cit.* (1985) 144, *op. cit.* (1989) 247; Whitmore, Tantra & Sutisna *op. cit.* 233; Mabberley *et al. op. cit.* 324; Turner, Gard. Bull. Sing. 47 (1995) 342; Argent *et al.* (eds.) *op. cit.* 420. **Basionym:** *Lansium cinereum* Hiern in Hooker f., Fl. Brit. Ind. 1 (1875) 558, King, J. As. Soc. Beng. 64, 1 (1875) 81, Ridley, FMP 1 (1922) 411. **Type:** Maingay 1908 [= *Kew Distr.* 339], Peninsular Malaysia, Malacca (holotype K). **Synonym:** *Aglaia pseudolansium* Kosterm. *op. cit.* (1966) 252.

Tree to 27 m tall; clear bole to 18 m tall, to 70 cm diameter. **Buttresses** to 1 m tall, extending out to 3 m, snake-like at extremities. **Bark** smooth with scaly patches and conspicuous knobby tubercles; inner bark white. **Sapwood** yellow. **Twigs** rather angular, with conspicuous petiole scars and dense indumentum when young, aluminium grey later. **Leaves** 10–15 cm long; *petioles* 1.5–2 cm long, *densely brown-tomentose*; *leaflets* chartaceous to subcoriaceous, *very sparsely pubescent below, lateral ones 2–4 (or 5) on each side of rachis; blades elliptical, 4–5.5(–8) × 1.5–2.5(–3.5) cm*, the most apical ones larger (to 11.5 × 4.5 cm), base weakly asymmetrical, cuneate, apex acuminate, *acumen 6–8*

mm long; midrib bristly brown-pilose on both surfaces; primary lateral veins 6–8 on each side of midrib, brown-pilose below, arcuate, with pilose domatia in their axils, *secondary ones inconspicuous*; petiolules *c.* 5 mm long, densely brown-tomentose, weakly swollen at base. **Inflorescences** spicate, to 10 cm long; peduncles densely pilose; bracts to 4 mm long, acute, often with smaller bracteoles. **Flowers:** calyx lobes *c.* 1 mm long, fawn-sericeous, margin ciliate; petals 4 mm long, ovate. **Fruits** globose, 1.5–2 cm diameter, glabrous, yellow.

Vernacular name. Sabah—*maliadoh* (Ladad Datu).

Distribution. Sumatra, Peninsular Malaysia and Borneo. In Borneo, known only in Sabah from Lahad Datu and Sandakan districts (e.g., *BNB FD 4659* and *SAN 29328*).

Ecology. Rain forest at altitudes to 700 m. Rarely collected.

Use. The sarcotesta is edible.

Notes. The leaflets are very similar to those of *Aglaia oligophylla* (q.v.) but are more-or-less alternate and have no stellate indumentum.

2. *Reinwardtiodendron humile* (Hassk.) Mabb.

Fig. 27.

(Latin, *humilis* = lowly; referring to the first tree described)

Mal. For. 45 (1982) 452, *op. cit.* (1985) 145, *op. cit.* (1989) 249; Whitmore, Tantra & Sutisna *op. cit.* 233; Mabblerley *et al. op. cit.* 326; Turner *op. cit.* 342; Argent *et al.* (eds.) *op. cit.* 422; Beaman & Anderson *op. cit.* 133. **Basionym:** *Lansium humile* Hassk., Retzia, ed. nov. 1 (1858) 121, Backer & Bakhuizen *f.*, FJ 2 (1965) 125. **Lectotype** (Mabblerley, 1982): *Hort. Bogor. III-B-47* ('417'), Java, Bogor, cultivated [ex Sumatra] (K). **Synonym:** *Aphanamixis humilis* (Hassk.) Kosterm. *op. cit.* (1966) 263, Backer & Bakhuizen *f.*, FJ 3 (1968) 654, [*'humile'*].

Tree to 27 m tall; bole to 40 cm diameter, fluted at base; flowering when small; buttresses to 4 m tall, to 5 m out. **Bark** smooth with scaly patches, fawn; inner bark yellow to reddish brown. **Sapwood** yellowish. **Twigs** with indistinct petiole scars, subglabrous except minutely pubescent apices, dark brown when dry. **Leaves** 15–20 cm long; petioles 2–4 cm long; leaflets chartaceous to subcoriaceous, glossy on both surfaces, more or less glabrous, lateral ones 2 or 3 on each side of rachis; blades elliptical to elliptical-obovate, (6–)8.5–10 × 1.8–3.5 cm, the most apical one larger (to 18 × 6.5 cm), base weakly asymmetrical, cuneate, apex markedly acuminate, acumen to 1.5 cm long; *primary lateral veins not clearly distinct from secondary ones*, particularly on the upper surface of leaflets, together some 20–30 on each side of midrib, parallel, straight, forming an angle of about 60° to midrib, anastomosing at margin, *prominent on both surfaces*, rarely with domatia in the axils above; petiolules 4–6 mm long, weakly swollen and channelled. **Inflorescences** spikes or panicles, to 15 cm long; peduncles very sparsely pubescent; bracts *c.* 2 mm long, acute, usually with a pair of smaller bracteoles, all sparsely pubescent. **Flowers:** calyx lobes orbicular, 1–2 mm long, margin ciliate; petals ovate to obovate, to 2.5 mm long, yellow. **Fruits** fig-shaped or obovoid, especially when immature, to 5 cm diameter, with apical depression and five sutures, densely but very shortly pilose, yellow. **Seed** 1 with white, sweet-tasting aril.

Vernacular name. Sabah—*langsar munit* (Malay).

Distribution. S China (Hainan), Indo-China, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines and Sulawesi. In Borneo, recorded in Sabah from Beaufort, Keningau, Kinabatangan, Lahad Datu, Ranau, Sandakan, Semporna and Tawau districts (e.g., *FRI* 40274, *Mabberley* 1672, *SAN* 26311, *SAN* 31284, *SAN* 76046 and *SAN* 89320) and in Sarawak from Kuching, Lundu and Serian districts (e.g., *S* 14628, *S* 73281 and *S* 78355). Also occurring in Brunei (e.g., *Wong WKM* 1097) and Kalimantan (e.g., *Kostermans* 8944 and *Kostermans* 9574).

Ecology. Rain forest at altitudes to 800 m.

3. *Reinwardtiiodendron kinabaluense* (Kosterm.) Mabb.

(from Mt. Kinabalu)

Blumea 31 (1985) 145; *Mabberley et al. op. cit.* (1995) 325; *Beaman & Anderson op. cit.* 133. **Basionym:** *Aglaia kinabaluensis* Kosterm. *op. cit.* (1966) 253. **Type:** *Chew et al. RSNB* 122, Borneo, Sabah, Mt. Kinabalu, eastern shoulder (holotype BO; isotypes CANB, K, L, SAN, SAR, SING).

Tree to 20(–35) m tall, to 25(–30) cm diameter and clear buttressed bole to 15 m tall. **Bark** smooth; inner bark yellow to white. **Sapwood** yellow. **Twigs** soon glabrous, appressed pilose at apices. **Leaves** to 27 cm long; *petioles* 4–5 cm long, *sparingly pubescent to glabrous*; *leaflets* chartaceous to subcoriaceous, *glabrous*, *lateral ones 1 or 2 on each side of rachis* (the leaves thus largely trifoliate); *blades oblong-elliptical*, 8–15 × 3–6.5 cm, the most apical one usually the largest (to 18 × 7 cm), base cuneate, apex acuminate, *acumen to 18 mm long*; primary lateral veins *c.* 7 on each side of midrib, arcuate, frequently with small domatia in their axils, *secondary ones less conspicuous*; *petiolules c.* 5 mm long, sulcate, swollen at base. **Inflorescences** spicate, to 8 cm long or basally branched panicles with 2 or 3 branches to 8 cm long; peduncles more or less pilose especially in high altitude specimens; bracts triangular, *c.* 1 mm long, pilose. **Flowers:** calyx lobes *c.* 1.5 mm long, more or less pilose, margin ciliate; petals ovate, 4–5 mm long. **Fruits** *depressed globose when young, obovoid with apical depression and 5 ribs when mature, to 5 cm long, sericeous*, yellow.

Distribution. Endemic in Borneo. Known in Sabah from Keningau, Ranau, Sandakan, Tawau and Tenom districts (e.g., *SAN* 44863, *SAN* 53864, *SAN* 81492 and *SAN* 92166) and in Sarawak from G. Gading, Lundu district (e.g., *SFN* 36099). Also occurring in Kalimantan (e.g., *Leighton* 756). Not yet recorded from Brunei.

Ecology. Rain forest at altitudes to 900 m. Rarely collected.

Notes. This species is remarkably similar in overall facies to *Aglaia oligophylla*, though the leaflets are larger in that species and its indumentum of stellate hairs, best seen in the fruit, distinguishes it at once. Furthermore, domatia are absent.

11. SANDORICUM Cav.

(from the Moluccan name, *sandori*, for *S. koetjape*)

kelampu (preferred name in Sabah and Sarawak), *sentul* (ASEAN trade name)

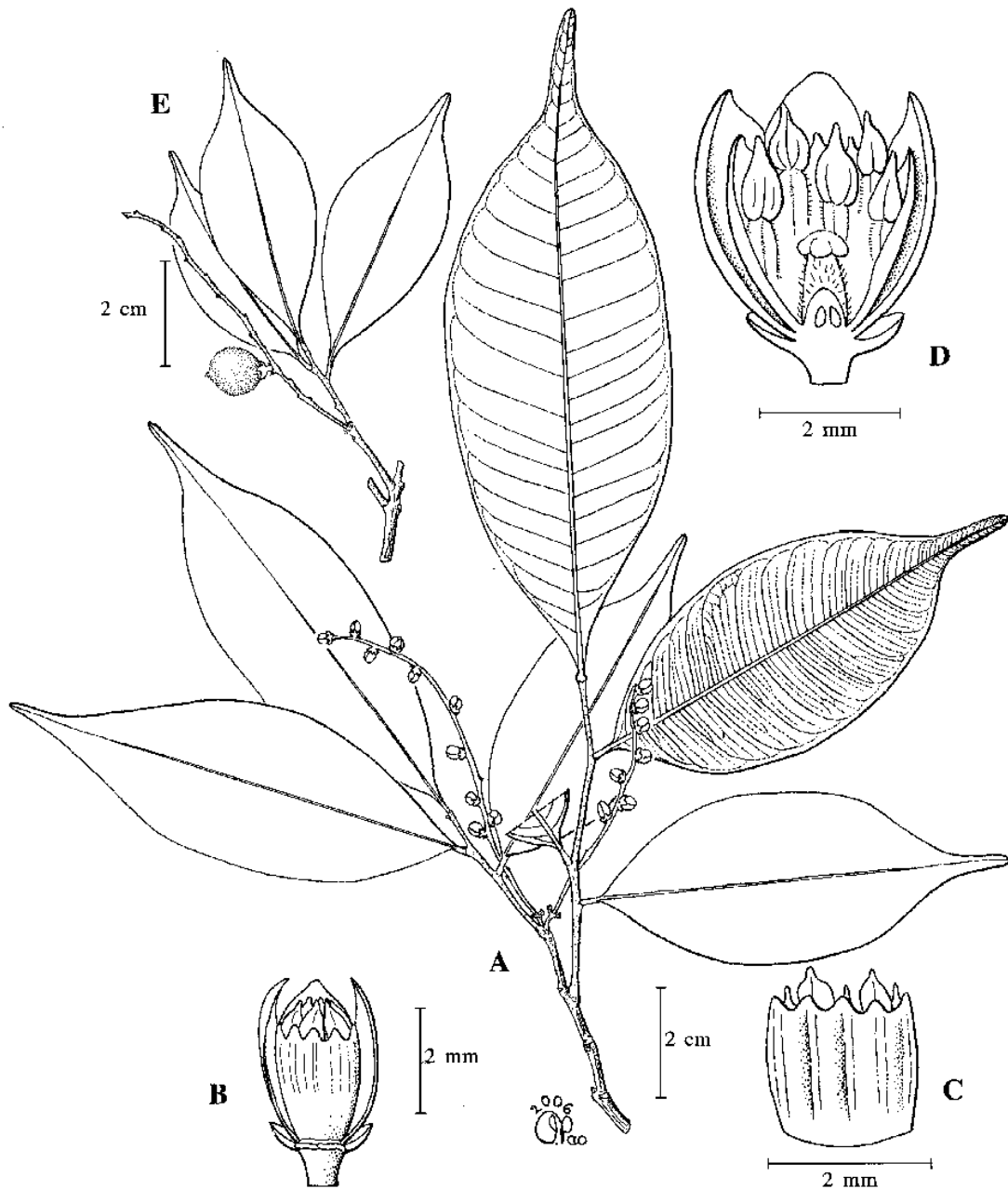


Fig. 27. *Reinwardtiodendron humile*. A, flowering leafy twig; B, flower with two petals removed; C, abaxial view of staminal tube; D, longitudinal section of flower; E, fruiting leafy twig. (A from Pennington 7876, B–D from SAN 84793, E from FRI 40274.)

Diss. 7 (1789) 359; Hiern *in* Hooker *f.*, Fl. Brit. Ind. 1 (1875) 553; King, J. As. Soc. Beng. 64, 1 (1895) 21; Ridley, FMP 1 (1922) 384; Merrill, Enum. Philip. Pl. 2 (1923) 381; Backer & Bakhuizen *f.*, FJ 2 (1965) 121; Pennington & Styles, Blumea 22 (1975) 507; Anderson, CLTS (1980) 252; Mabberley, Blumea 31 (1985) 146, *in* Mabberley & Pannell, TFM 4 (1989) 249, PB 2nd. ed. (1997) 636; Corner, WSTM 3rd. ed., 2 (1988) 504; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 234; Mabberley *et al.*, FM 1, 12 (1995) 344; Coode *et al.* (eds.), CLBD (1996) 206; Argent *et al.* (eds.), MNDT-CK 2 (1997) 422; PROSEA 5, 3 (1998) 497; Beaman & Anderson, PMK 5 (2004) 133.

Trees. **Indumentum** of simple hairs. **Bud scales** absent. **Leaves** spirally arranged, trifoliate, without pseudogemma. **Inflorescences** axillary thyrses. **Flowers** bisexual; calyx more or less truncate to shallowly 4- or 5-lobed; petals (4 or) 5, free, aestivation imbricate; staminal tube cylindrical, ribbed distally, margin with 5 or 10 short lobes, anthers 10, glabrous, included; disc tubular, free, margin coarsely toothed; ovary slightly sunk in receptacle, 4- or 5-locular, each locule with 2 collateral ovules, stylehead with 4- or 5-lobed stigma. **Fruits** drupaceous, 1–5-locular, pyrenes 1(or 2)-seeded; outer mesocarp rather dry-fleshy or soft and fibrous, inner mesocarp fleshy or spongy-fibrous; endocarp thin, cartilaginous. **Seeds** kidney-shaped, laterally compressed, non-arillate, pachychalazal with thin sarcotesta; endosperm absent; embryo with thick, planoconvex, collateral cotyledons; radicle apical, extending to surface or slightly exerted. Germination phanerocotylar; eophylls trifoliate, opposite.

Distribution. Five species, all but one, *Sandoricum koetjape*, restricted to W Malesia, where the cultivated forms of *S. koetjape* (q.v.) may have arisen, though wild plants appear to be native as far east as New Guinea. All five are wild in Borneo, to which three are restricted.

Ecology. Mixed dipterocarp, *kerangas* and other forest types. *Sandoricum beccarianum* is restricted to peatswamp forest, *S. borneense* to riparian forest.

Uses. The fruit (where known as mature) of all species is edible and the timber is locally used for house construction and for making furniture, cabinets, joineries, planks, packing cases, wood-carving items, and agricultural and household implements. The wood is also suitable for manufacturing veneer, plywood, blockboard, pulp and paper (PROSEA *op. cit.* (1998) 206).

Key to *Sandoricum* species

1. Leaflets obovate (to elliptical), apex rounded or emarginate. Tree of peatswamp forests.....**1. S. beccarianum**
 Leaflets lanceolate, ovate (or elliptical), apex acuminate to caudate. Trees of other habitats.....2
2. Leaflets glabrous, lanceolate-ovate or elliptical, base obtuse to rounded.....**2. S. borneense**
 Leaflets pubescent to subglabrous (or glabrous), ovate, base cuneate to rounded.....3
3. Leaflets caudate (acumen to 24 mm long), base cuneate.....**3. S. caudatum**
 Leaflets acute to acuminate (acumen never more than 15 mm long), base rounded, obtuse to acute (or subcuneate).....4

4. Calyx 4–4.5 mm tall, dark purplish brown; petals glabrous; staminal tube with 5 erose (= irregularly splitting) lobes; petiolule of apical leaflet 4–10 cm long.....**4. *S. dasyneuron***
 Calyx *c.* 3.5 mm tall, yellow-green; petals more or less pubescent; staminal tube with 10 bifid lobes; petiolule of apical leaflet 3–5.5 cm long.....**5. *S. koetjape***

1. *Sandoricum beccarianum* Baill.

Fig. 28.

(Odoardo Beccari, 1843–1920, traveller in Borneo, Director of the Botanic Garden and Herbarium in Firenze, Italy)

Adansonia 11 (1874) 264; Mabberley *op. cit.* (1985) 151, *op. cit.* (1989) 249; Mabberley *et al. op. cit.* 353; Turner, Gard. Bull. Sing. 47 (1995) 342; Argent *et al.* (eds.) *op. cit.* 422; PROSEA *op. cit.* (1998) 500. **Type:** *Beccari 3111*, Borneo, Sarawak, (holotype P; isotypes FI, G-DC, K). **Synonym:** *Sandoricum emarginatum* Hiern *op. cit.* 264, King *op. cit.* 22, Merrill, EB (1921) 319, Ridley *op. cit.* (1922) 385, Masamune, EPB (1942) 376, Anderson *op. cit.* (1980) 253.

Tree to 35 m tall; bole to 25 m tall and 70 cm diameter. **Bark** smooth with minute cracks to deeply fissured; inner bark red-brown, to 10 mm thick. **Sapwood** whitish to pale brown; heartwood pink to red-brown. **Twigs** 3–5 mm diameter apically. **Indumentum** restricted to innovations. **Leaves** 11–25 cm long; petioles 3–7 cm long, weakly swollen and flattened adaxially at base; *leaflets obovate (to elliptical)*, apical ones 5.5–14 × 3.5–9 cm, lateral ones 4–12 × 2.5–7 cm, base acute to subcuneate, *apex emarginate or rounded (to obtuse)*, sometimes mucronate; lateral veins 6–8 on each side of midrib, weakly arcuate and rather obscurely looped near margin; petiolules 3.5–10 mm long on lateral leaflets, 4–6 cm long on apical leaflets, all somewhat swollen at junctions with leaflet blade and when dry grooved adaxially. **Inflorescences** 1–5.5 cm long, produced with new leaves and from axils of fallen leaves up to at least ten nodes from apex, fasciculate (apparently arising in the axils of undeveloped leaves in axillary buds); primary branches to 2 cm long, bearing fascicles of 1–4 flowers; axes minutely puberulous to glabrous; bracts narrowly triangular, *c.* 1 mm long, pubescent, caducous. **Flowers:** bracteoles 1–3, narrowly triangular, *c.* 0.5 mm long, pubescent, borne half way up pedicel to articulation with pseudopedicel; pedicels 4–6 mm long, conspicuously articulated with pseudopedicel *c.* 1 mm long, continuous with calyx; calyx shallowly cup-shaped, 2–2.5 mm tall, subpuberulous, red-brown, margin truncate to irregularly (4 or) 5-lobed, the lobes to 1 mm deep, obtuse, margin more or less ciliate; petals (4 or) 5, oblanceolate, 6–7 × 2.5 mm, yellow-green to white, glabrous; staminal tube fleshy, deeply (16–)20-ribbed, cream, subpilose inside, margin with (8–)10 emarginate lobes, anthers (8–)10, ovate, apiculate, *c.* 1 mm long, in one rank, inserted opposite lobes, very weakly exerted; disc *c.* 2 mm tall, membranous, glabrous, margin irregularly lacinate (= incised); ovary and style glabrous, stigmatic lobes *c.* 1 mm long. **Fruits** (immature) subglobose, *c.* 3 × 2.5 cm, stipitate, stipe to 5 mm long, densely minutely tomentellous, orange-red or pinkish yellow; pericarp with white latex. **Seeds** 2, *c.* 2 × 1 cm.

Vernacular names. Sabah—*langsar-langsar* (Malay), *lantupak mata kuching* (preferred name), *mata kuching ambok* (Malay), *mata kuching hutan* (Malay). Sarawak—*apau* or *ubah apau* (Melanau), *dual merah* (Bisayah), *kelampu paya* (Iban).

Distribution. Thailand, coastal regions of Sumatra, Peninsular Malaysia and Borneo. In Borneo, recorded in Sabah from Beaufort and Papar districts (e.g., *SAN 56053* and *SAN 78019*) and in Sarawak from Bintulu, Daro, Kuching, Lundu, Sarikei and Sri Aman districts

(e.g., *S 12418*, *S 20868* and *S 30262*). Also occurring in Brunei (e.g., *FD FMS 34486*) and Kalimantan (e.g., *Kostermans 6059* and *Kostermans 8149*).

Ecology. Peat swamp forests, where it can be co-dominant locally, at altitudes to 30 m. In Sarawak, generally found only where *ramin* is common.

2. *Sandoricum borneense* Miq. (from Borneo)

Ann. Mus. Bot. Lugd.-Bat. 4 (1868) 33; Merrill *op. cit.* (1921) 319; Masamune *op. cit.* 376; Anderson *op. cit.* (1980) 252; Mabberley *op. cit.* (1985) 150; Whitmore, Tantra & Sutisna *op. cit.* 234; Mabberley *et al. op. cit.* 351; Coode *et al. (eds.) op. cit.* 206; Argent *et al. (eds.) op. cit.* 422; PROSEA 5, 3 (1998) 500. **Type:** *Korthals s.n.*, Borneo, Kalimantan, Sg. Tewe, Sept. 1836 (holotype L [*Acc. No. 908133605*]).

Tree, 7–20 m tall; bole to 15 m tall and 20–40(–60) cm diameter, unbuttressed. **Bark** smooth, pale brown, with small lenticels; inner bark light brown or pinkish. **Sapwood** white. **Twigs** 3–4(–5) mm diameter apically, smooth, often pale when dry. **Indumentum** restricted to innovations. **Leaves** 22–38 cm long, red when young; petioles 4–10 cm long, terete to somewhat flattened adaxially near base; *leaflets glabrous*; *blades elliptical to lanceolate-ovate*, 8–22 × 3.5–8.5 cm, apical leaflet not conspicuously larger than lateral ones, *base obtuse to rounded*, those of lateral leaflets often markedly asymmetrical, *apex acuminate*; lateral veins 9–12 on each side of midrib, arising almost at right angles from midrib, very weakly arcuate and looped at margin; petiolules 3–5(–10) mm long on lateral leaflets, 20–45 mm on apical leaflets. **Inflorescences** 10–16 cm long, more or less erect, narrow, fragrant; primary branches to 6 cm long, subsquarrose to weakly ascending, the secondaries *c.* 1.5 cm long, bearing cymes of 1–5 flowers; bracts narrowly triangular, *c.* 8 mm long, to foliaceous, when lanceolate to oblanceolate, *c.* 2 cm long and petiolate, caducous. **Flowers:** bracteoles narrowly triangular, *c.* 4 mm long, caducous; pedicels 3–7 mm long, glabrous to subpuberulous; calyx shallowly cup-shaped, 1.5–2 mm tall, more or less puberulous, pale green, splitting irregularly into 5 obtuse lobes *c.* 0.5 mm deep; petals 5, linear-oblong, 6–8 mm long, glabrous, creamy-green to pinkish, apex acute; staminal tube creamy-green to pinkish, glabrous and with *c.* 20 ribs outside, villous inside, margin 10-lobed, each lobe more or less bifid, anthers *c.* 0.5 mm long in two ranks, alternating with the lobes, apiculate, weakly exerted; disc *c.* 2 mm tall, glabrous, margin 5-lobed, the lobes more or less bifid; ovary and style glabrous, stigmatic lobes *c.* 1 mm long. **Fruits** subglobose to pyriform, 2.5–4 cm diameter, velutinous, buff-yellow to orangeish, obscurely longitudinally ribbed, usually solitary; pericarp with milky latex; mesocarp sweet but mealy; endocarp tough; pyrenes 2–5. **Seeds** *c.* 14 × 9 mm.

Vernacular names. Sarawak—*apoh* (Berawan, Kayan), *apok* (Kenyah), *kelampu* (Iban).

Distribution. Endemic in Borneo. Known in Sabah from Beaufort, Kota Belud, Papar, Sandakan, Sipitang and Tawau districts (e.g., *SAN 27996*, *SAN 32159*, *SAN 72288* and *SAN 78172*) and in Sarawak from Bau, Belaga, Bintulu, Kapit, Kuching, Lubok Antu, Lundu, Marudi, Miri and Tatau districts (e.g., *S 19929*, *S 29970*, *S 39662*, *S 45140* and *S 50094*). Also occurring in Brunei (e.g., *BRUN 152* and *SAN 17051*) and Kalimantan (e.g., *Veldkamp 8377*).

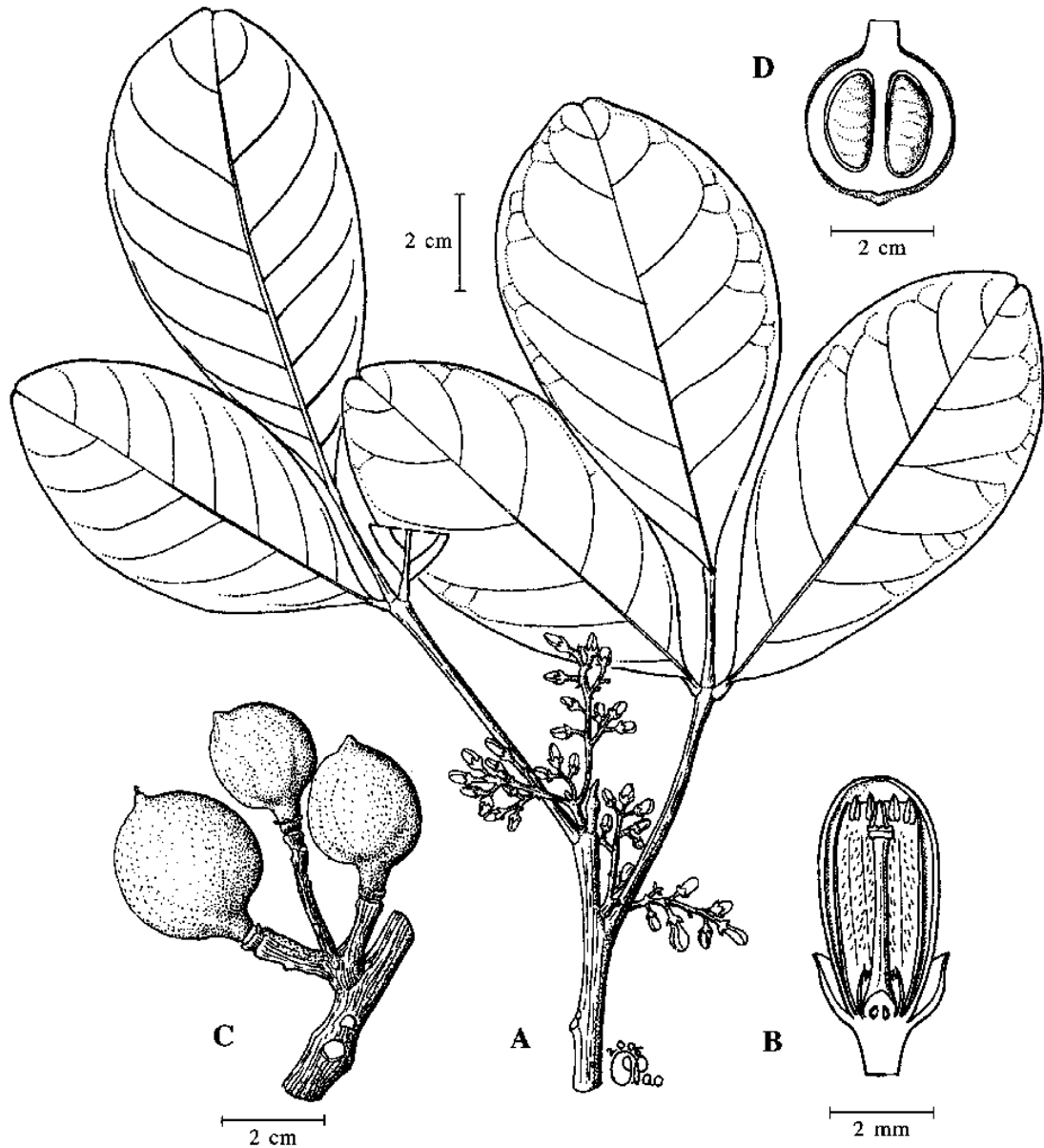


Fig. 28. *Sandoricum beccarianum*. A, flowering leafy twig; B, longitudinal section of flower; C, infructescence; D, longitudinal section of fruit. (A–B from *Kostermans 8149*, C–D from *S 12418*.)

Ecology. Riverbanks, subject to inundation, from 330 m down to just above tidal influence. The fruits fall into the water and are devoured by fish, which appear to spit out the pyrenes: whether or not such leads to effective dispersal is unrecorded.

Uses. In Sarawak, the wood is used for making *sape*, an Iban musical instrument.

3. *Sandoricum caudatum* Mabb.

Fig. 29.

(Latin, *caudatus* = ending with a tail-like appendage; referring to the elongated leaflet tip)

Blumea 31 (1985) 150; Whitmore, Tantra & Sutisna *op. cit.* 234; Mabberley *et al. op. cit.* 352; Coode *et al. (eds.) op. cit.* 206. **Type:** *Haviland 2851*, Borneo, Sarawak, Kuching district (holotype K; isotype SAR).

Small tree to 10 m tall; bole to 15 cm diameter. **Bark** smooth, grey-green. **Twigs** 3–4 mm diameter apically. **Indumentum** fulvous, restricted to innovations. **Leaves** 20–25 cm long; petioles 5–9 cm, wrinkled, base swollen and flattened adaxially; *leaflets subglabrous*; *blades ovate*, apical leaflets 14–15.5 × 6–7 cm, lateral ones 10–13 × 4–6 cm, *base cuneate*, more or less asymmetrical on lateral leaflets, *apex caudate*, *acumen to 24 mm long*; lateral veins 8–10 on each side of midrib, arcuate, looped well clear of margin; petiolules wrinkled when dry, 6–9 mm long on lateral leaflets, 4–5 mm long on apical ones. **Inflorescences** 4–7 cm long, sparsely branched, borne in axils of undeveloped leaves; primary branches to 2 cm long, squarrose, bearing fascicles of 2 or 3 flowers; axes minutely puberulous; bracts subtending primary branches narrowly lanceolate, 5–7 mm long, puberulous, caducous. **Flowers:** bracteoles at base of pedicels smaller, often with 1 or 2 more, smaller ones half way to articulation with pseudopedicel; pedicels 5–6 mm long; pseudopedicels 1–2 mm long continuous with calyx; calyx shallowly campanulate, *c.* 2.5 mm tall, more or less puberulous, pale green, splitting into 5 irregular obtuse lobes *c.* 0.75 mm deep, margin ciliate; petals 5, elliptical, *c.* 4.5 × 2 mm (immature), apex rounded, creamy-white; staminal tube glabrous outside, villous inside, margin with 10 irregular lobes, creamy-white, anthers 10, more or less in two ranks, alternating with lobes, oblong, *c.* 0.75 mm long, weakly exserted; disc *c.* 1.5 mm tall, glabrous, membranous, clasping ovary, margin lacinate; ovary and style glabrous, stigmatic lobes *c.* 1 mm long. **Fruits** solitary, at least 5 × 3.5 cm, stipitate, rostrate, stipe to 1 cm long, beak to 6 mm long, densely yellow-brown velutinous, somewhat ribbed longitudinally, calyx accrescent; pyrenes 3 or 4. **Seeds** *c.* 16 × 9 mm (immature).

Distribution. Endemic in Borneo, known only in Sarawak from Belaga, Betong, Kuching, Miri, Serian, Sri Aman and Tatau districts (e.g., *Purseglove 4990*, *S 20298*, *S 26874*, *S 41782*, *S 47156* and *S 59691*) and in Brunei (e.g., *Dransfield JD 7308* and *FD FMS 30440*).

Ecology. Lowland dipterocarp forest and *kerangas* forest at altitudes to 350 m.

Notes. Neither mature flowers nor mature fruits collected.

4. *Sandoricum dasyneuron* Baill.

(Greek, *dasy-* = shaggy, *neuron* = nerve; referring to the bristly veins on the underside of the leaflet)

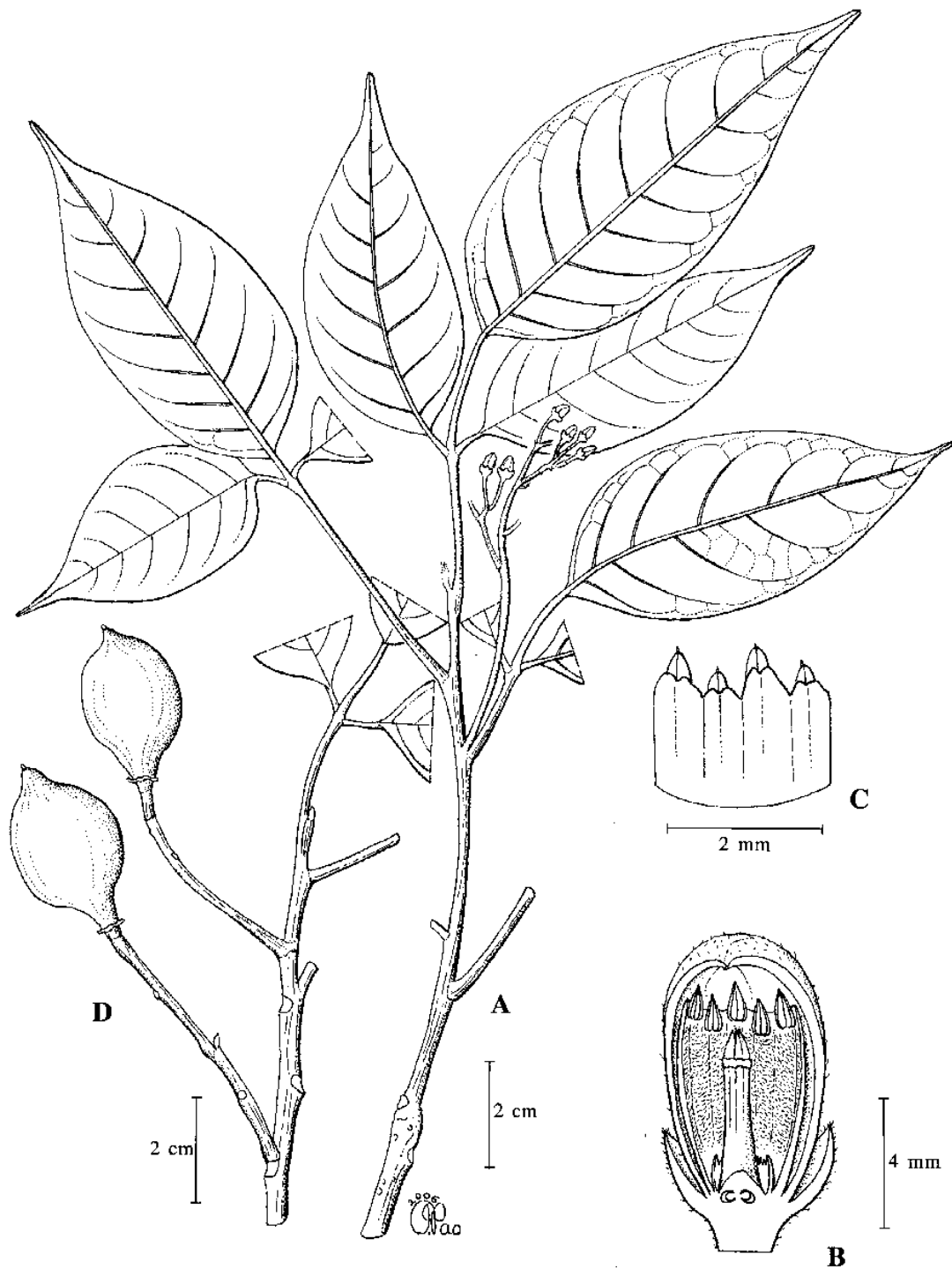


Fig. 29. *Sandoricum caudatum*. A, flowering leafy twig; B, longitudinal section of flower; C, abaxial view of staminal tube; D, fruiting leafy twig. (A–C from *Ong* 730, D from *S* 44932.)

Adans. 11 (1874) 265; Beccari, Nelle For. Born. (1902) 602; Merrill *op. cit.* (1921) 319; Masamune *op. cit.* 376; Anderson *op. cit.* (1980) 252; Mabberley *op. cit.* (1985) 147; Whitmore, Tantra & Sutisna *op. cit.* 234; Mabberley *et al. op. cit.* 345; Coode *et al. (eds.) op. cit.* 206. **Type:** Beccari 299, Borneo, Sarawak (holotype P; isotypes BP, G-DC, M).

Tree, 8–10(–25) m tall; bole 10–25 cm diameter. **Bark** smooth. **Sapwood** light red. **Twigs** 6–8 mm diameter apically. **Indumentum** ferrugineous. **Leaves** 25–52 cm long; petioles 10–20.5 cm long, more or less pilose, base somewhat swollen; *leaflets glabrous above, more or less pilose below especially on veins; blades broadly ovate*, apical leaflets 17–24 × 12–16 cm, lateral ones 16–20 × 10–11 cm, *base acute to subcuneate, apex acuminate, acumen to 15 mm long*; lateral veins (10 or) 12 or 13 on each side of midrib, inarched only near margin; *petiolules* 3–15 mm long on lateral leaflets, *4–10 mm long on apical ones*. **Inflorescences** 2–13 cm long, produced with new leaves over at least 6 nodes, sparsely branched often from very close to base; primary branches to 6 cm long, squarrose, bearing fascicles of 1–3 flowers; axes densely short-tomentose; bracts narrowly triangular, *c.* 7 mm long, densely pubescent, caducous. **Flowers** weakly scented; bracteoles narrowly triangular, 1–2 mm long, densely pubescent, caducous; pedicels 5–7 mm long, articulated with pseudopedicel 1(–2) mm long, continuous with calyx; *calyx* campanulate, *4–4.5 × 4–5 mm*, glabrous, *dark purplish brown*, splitting into 5 irregular obtuse lobes to 1 mm deep, margin ciliate; *petals* 5, spatulate, *8–9 × 3 mm*, *glabrous*, greenish white, apex acute; *staminal tube* fleshy, white, swollen at mouth, subpubescent outside, pilose inside, *margin with 5 erose lobes*, anthers 10, *c.* 1.5 mm long, in two ranks, the more distal ones opposite lobes, the more proximal ones inserted between them, all weakly exerted; disc *c.* 2 mm tall, narrowing towards mouth, membranous, glabrous, margin irregularly lacinate; ovary and style glabrous, stigmatic lobes *c.* 1.5 mm long. **Fruits** globose-pyriform, when mature 10 cm diameter, densely and minutely fulvous-tomentellous, multi-ribbed longitudinally; pyrenes at least 3, bean-shaped. **Seeds** 2.5 cm long.

Vernacular names. Sarawak—*atap bojig* (Land Dayak), *kelampu* (Iban, Malay), *krunkok* (Iban).

Distribution. Endemic in Borneo, known only in Sarawak from Bau, Bintulu, Kapit, Kuching, Marudi and Sri Aman districts (e.g., *S* 14361, *S* 24649, *S* 28999 and *S* 44047) and in Brunei (e.g., *Niga NN* 337) and Kalimantan (e.g., *Burley et al.* 785).

Ecology. Hill-sides and ridges in mixed dipterocarp forest and ecotone to *kerangas* (Sarawak), *Agathis* forest on acid sands (E Kalimantan), at 50–600 m altitude.

5. *Sandoricum koetjape* (Burm.f.) Merr.

(from an Indonesian plant name—*ketjapi*)

Phil. J. Sci. Bot. 7 (1912) 237, *op. cit.* (1921) 319, *op. cit.* (1923) 361; Masamune *op. cit.* 377; Backer & Bakhuizen *f. op. cit.* (1965) 121; Mabberley *op. cit.* (1985) 147, *op. cit.* (1989) 249; Corner *op. cit.* (1988) 504; Whitmore, Tantra & Sutisna *op. cit.* 234; Mabberley *et al. op. cit.* 345; PROSEA 2 (1991) 284, *op. cit.* (1998) 500; Turner *op. cit.* 342; Argent *et al. (eds.) op. cit.* 422; Beaman & Anderson *op. cit.* 133. **Basionym:** *Melia koetjape* Burm.f., Fl. Ind. (1786) 101. **Type:** Anon. s.n. in *Herb. Burman*, Java (holotype G). **Synonyms:** *Sandoricum indicum* Cav., *op. cit.* 359, Hiern *op. cit.* 553, King *op. cit.* 23, Ridley *op. cit.* (1922) 385; *Sandoricum nervosum* Blume, Bijdr. Fl. Ned. Ind. (1825) 163, Ridley *op. cit.* (1922) 385; *Sandoricum maingayi* Hiern *op. cit.* 554, Merrill *op. cit.* (1921) 319,

Ridley *op. cit.* (1922) 385, Anderson *op. cit.* (1980) 253; *Sandoricum maingayi* Hiern var. *quadripetalum* C.DC. in A.P. de Candolle, Mon. Phan. 1 (1878) 462, Merrill *op. cit.* (1921) 319; Masamune *op. cit.* 377; *Sandoricum radiatum* King *op. cit.* 21, Ridley, Agr. Bull. Str. Fed. Malay St. 1 (1902) 429; *Sandoricum vidalii* Merr., Philip. Govt. Lab. Bur. Bull. 6 (1904) 8, *op. cit.* (1923) 361; Anderson *op. cit.* (1980) 353.

Tree to 45(–50) m tall; bole to 1 m diameter, fluted and sometimes with buttresses to 3 m tall. **Bark** pale pinkish brown, smooth, lenticellate to peeling with round flakes; inner bark pink. **Sapwood** pale yellow; heartwood pink or reddish. **Twigs** with distinct petiole scars, lenticellate, rough, grey-brown, 4–7 mm diameter apically, subglabrous to fulvous-tomentose. **Leaves** 18–40 cm long; petioles 7.5–16 cm long, flattened (or even winged when dry) adaxially towards the more or less swollen base, subglabrous to fulvous-pubescent; *leaflets glabrous or with a few brown hairs on midrib above, subglabrous to densely brown-pubescent below*, pink when young, withering yellow or reddish; *blades ovate*, apical ones 8–20 × 5–14 cm, lateral ones usually smaller and narrower, *base acute to rounded*, more or less asymmetrical on lateral leaflets, *apex acuminate, acumen less than 15 mm long*; lateral veins 7–14 (–20 in cultivated forms) on each side of midrib, looped near margin; *petiolules* 4–9 mm long on lateral leaflets, *3–5.5 cm long on apical ones*. **Inflorescences** 2.5–24 cm long, produced in up to 8 of the most apical leaf axils, erect or weakly drooping; axes more or less fulvous-pubescent; primary branches to 8 cm long, squarrose, bearing secondary branches of glomerules of 1–5 flowers; bracts narrowly triangular, *c.* 7 mm long, densely pubescent, caducous. **Flowers** fragrant; bracteoles somewhat smaller than bracts, subopposite; pedicels 3–5 mm long, articulated with pseudopedicels 1–1.5 cm long, continuous with calyx; *calyx* campanulate to cup-shaped, *c.* 3.5 mm tall, splitting into 5 irregular obtuse or rounded lobes to 0.75 mm deep, pubescent, margin ciliate, *yellow-green*; *petals* (4 or) 5, linear-lanceolate to oblanceolate, 6–9 mm long, yellowish green or pinkish, *more or less pubescent outside*, reflexed at anthesis, apex rounded to emarginate; *staminal tube* more or less pubescent outside, pilose inside, pale yellow to orangeish, *margin with 10 acute to bifid lobes*, somewhat reflexed at anthesis, anthers (8 or) 10, narrowly oblong, 1–1.5 mm long, apiculate, more or less in 2 ranks, weakly exerted; disc *c.* 1.5 mm tall, membranous, glabrous, margin irregularly lacinate; ovary and style glabrous, stigmatic lobes *c.* 1.5 mm long. **Fruits** depressed globose, 5–8 cm diameter, velvety, yellow or brownish when ripe, smooth to longitudinally wrinkled; pericarp with milky latex; mesocarp white, translucent, juicy sweet to very sour; endocarp tough with 1 or 2 seeds. **Seeds** 20–35 × 12–21 × 9–16 mm.

Vernacular names. Throughout Malesia and beyond, different forms are known variously as *sentul* (or variants) and *kechapi* (or variants) though apparently not consistently, even within an island.

Distribution. Planted widely in tropical Asia but the wild form probably extending from Peninsular Malaysia and Sumatra to New Guinea (Madang). In Borneo, recorded in Sabah from Beaufort, Kinabatangan, Lahad Datu, Penampang, Sandakan and Tawau districts (e.g., *SAN 32841*, *SAN 97075*, *SAN 105172*, *SAN 108515* and *SAN 139760*) and in Sarawak from Bau, Belaga, Bintulu, Kanowit, Kapit, Kuching, Lundu, Marudi, Miri, Serian and Simunjan districts (e.g., *Mabberley 1588*, *S 4037*, *S 28891*, *S 48161* and *S 79121*). Also occurs in Brunei (e.g., *Forman 1121*) and Kalimantan (e.g., *Burley et al. 785*).

Ecology. Native and naturalised in different types of forests at altitudes to 1200 m or more.

Uses. Grown, largely as village trees, for shade as well as fruit. The mesocarp is the part eaten: it is derived from the inner pericarp walls and as outgrowths from the endocarp. In

some forms it is exceedingly sweet but the sour ones may be ‘excruciating’. The tree is fast-growing when young: it is recommended as an avenue tree. The timber is red, moderately hard and takes a fine polish. It has been used for barrels, boats, carts and butchers’ blocks. The bark has been used in tanning fishing nets. Bark and also, particularly, the roots are claimed as effective in the treatment of a number of medical conditions. Some of the triterpenoids extracted from the stems have been shown to have significant cytotoxic activity against cultured cancer cells and to be insect antifeedants: extracts are promising as anti-inflammatories (*FRIM in Focus* Jan-Mar 2003: 7), though the effective agents have yet to be characterised.

Notes. The form known as *kechapi* in the narrow sense, i.e. that with robust pubescent twigs, a brown pubescent upper surface to the leaves, which are large, wither red, and have many lateral veins in the leaflets, is that most frequently encountered in the Philippines and elsewhere in the tropics (Sarawak – *S* 35985 from G. Santubong): planted in Sabah (*SAV* 97075). Wild trees in Peninsular Malaysia to New Guinea, beyond the range of cultivation of *kechapi*, have more delicate twigs, smaller subglabrous leaves, withering yellow, the leaflets with fewer veins and pinkish petals in rather shorter inflorescences, the fruits sweet-tasting with thinner smoother pericarp and falling when ripe. In the Philippines and from Sulawesi eastwards, the two forms seem perfectly distinct, but in Borneo and westwards it becomes impossible to draw a clear line between them, where the array of forms apparently spans the range from the wild form found elsewhere to something more approaching *S. dasyneuron*, with the cultivated *sentul* nearer the first, *kechapi* the second. Careful analysis of ‘wild’ populations might shed light on the origins of the various cultivars, of which one, at least, is tetraploid. Very rarely the apical leaflet is deeply trilobed (e.g., *S* 43449).

12. TOONA (Endl.) M.Roem.

(from *toon*, the Indian name for *T. ciliata*)

surian (preferred trade name)

Jennifer M. Edmonds & David J. Mabberley

Fam. Nat. Syn. Monogr. 1 (1846) 131, 139; Merrill, Enum. Philip. Pl. 2 (1923) 357; Backer & Bakhuizen *f.*, FJ 2 (1965) 117; Pennington & Styles, Blumea 22 (1975) 512; Anderson CLTS (1980) 253; Mabberley *in* Mabberley & Pannell, TFM 4 (1989) 256, PB 2nd. ed. (1997) 718; Edmonds, Commonw. For. Rev. 72 (1993) 181, *in* Mabberley *et al.*, FM 1, 12 (1995) 358; PROSEA 5, 2 (1995) 492; Argent *et al.* (eds.), MNDT-CK 2 (1997) 424; Beaman & Anderson, PMK 5 (2004) 134. **Basionym:** *Cedrela* L. sect. *Toona* Endl., Gen. Pl. 2 (1840) 1055. **Synonym:** *Cedrela* L., *p.p.*, Hiern *in* Hooker *f.*, Fl. Brit. Ind. 1 (1875) 568, King, J. As. Soc. Beng. 64, 1 (1895) 89, Ridley, FMP 1 (1922) 415, Symington, Mal. For. 4 (1935) 119.

Deciduous or semi-evergreen, monoecious trees. **Indumentum** of simple hairs. **Bud scales** present. **Leaves** spirally arranged, usually *paripinnate*, without *pseudogemmula*; leaflets more than 8 on each side of rachis, opposite or subopposite, not strongly asymmetrical, margin entire to serrate, domatia usually present. **Inflorescences** much-branched thyrses. **Flowers** unisexual, rarely bisexual; calyx 5(or 6)-lobed or 5 (or 6) sepals free, imbricate to cup-shaped in bud; petals 5 (or 6), much less than 12 mm long, free, aestivation imbricate

(quincuncial), usually adnate to the *pulvinate, cushion-shaped androgynophore* (disc); *stamens* 5 (or 6), *free*, arising from androgynophore, sometimes alternating with 1–5 filamentous staminodes; ovary 5-locular, each locule with 6–10 ovules, stylehead discoid, usually 5-rayed. **Fruit** a woody septifragal capsule, valves opening from apex; columella softly woody, 5-angled, extending to capsule apex. **Seeds** *winged at both ends, when attached distally, or at one end, when attached by seed-end to proximal part of the columella*; endosperm residual; embryo with collateral, flattened, leaf-like cotyledons; radicle laterally exerted. Germination phanerocotylar; eophylls opposite, trifoliate, the leaflets deeply lobed or dentate.

Distribution. Four or five species from E Pakistan to S China and E Australia, with *T. ciliata* M.J.Roem. (*toon*) almost throughout the range. In Sabah and Sarawak, two species are known.

Ecology. In Sabah and Sarawak species of *Toona* occur in lowland to lower montane forests at altitudes to 1300 m. The trees are frequently associated with riverine habitats.

Uses. Valuable timbers especially *T. ciliata*, which, as red cedar, was the most important cabinet timber in Australia. In SE Asia, the *surian* timber is widely used for light construction work, furniture, joinery, cabinet work, packing cases and boxes, decorative panelling, musical instruments, wood-carvings, veneer and plywood.

Notes. Seriously under-recorded in the Flora area, partly due to their tall smoothish, straight boles making specimen collection difficult, and because the fruits mature several months after flowering. The descriptions have therefore had to be based, at least in part, on materials from outside the Flora area. *Toona sinensis* (A.Juss.) M.Roem, a high-altitude species in Peninsular Malaysia, recognisable by its serrate leaflets, completely glabrous flowers and unpleasant-smelling shoots has been recorded from Borneo in error.

Key to *Toona* species

Twigs inconspicuously lenticellate with minute lenticels. Leaflets usually glabrescent on midrib above. Flower buds with inconspicuous shortly ciliate fringe to petal margins, not forming bands; styles glabrous. Fruit valves smooth to lenticellate with small inconspicuous lenticels, red or light to reddish brown. **1. *T. ciliata***
 Twigs prominently lenticellate with warty lenticels. Leaflets usually conspicuously pilose on midrib above. Flower buds usually with dense ciliate bands of long hairs on petal margins; styles pilose. Fruit valves verrucose with conspicuous rusty lenticels, darkish or blackish brown. **2. *T. sureni***

1. *Toona ciliata* M.Roem.

Fig. 30.

(Latin, *ciliatus* = with fine hairs, resembling an eyelash; referring to the margins of petals and sepals)

Fam. Nat. Syn. Monogr. 1 (1846) 139; Edmonds *op. cit.* (1995) 366; PROSEA 5, 2 (1995) 497; Turner, Gard. Bull. Sing. 47 (1995) 342; Beaman & Anderson *op. cit.* 134. **Basionym:** *Cedrela toona*

Roxb. *ex* Rottl. *apud* Willd., Neue Schrif. Naturf. Freunde Berlin 4 (1803) 198; Hiern *op. cit.* 568. **Type:** *Klein s.n. in Herb. Willd.* 4828¹, India, Madras, 1799 (holotype B-WILLD; isotypes K, LIV [microfiche seen]). **Synonyms:** *Toona hexandra* M.Roem. *op. cit.* 139; *Surenus toona* (Rottl.) Kuntze, Rev. Gen. Pl. 1 (1891) 111; *Toona ciliata* M.Roem. var. *hexandra* (M.Roem.) Bahadur, Monogr. *Toona* (1988) 93. (For complete synonymy *cf.* Edmonds *op. cit.* 1995.)

Tree to 35 m tall; bole to 22 m tall, with or without buttresses (to 3.5 m); crown usually rounded, spreading to 21 m across, occasionally dense. **Bark** white, greyish white to brown, usually fissured and flaking; inner bark brown to reddish, fibrous. **Sapwood** white, pink or red; heartwood pinkish red; sweetly aromatic when cut. **Twigs** glabrescent to pilose, *inconspicuously lenticellate with small lenticels*. **Leaves** (15–)26–35(–69) cm long; rachises glabrous to sparsely pilose, often reddish; petioles 6–9(–11) cm long, glabrous to pilose; *leaflets* (5–)8–10(–15) on each side of rachis, *glabrescent with scattered hairs on upper surface of midribs*, glabrescent to pilose on lower surfaces, rarely velutinous on both surfaces; blades lanceolate to ovate-lanceolate, (7)9–13.5(–16) × (2.2–)3.6–4.8(–6) cm, base usually asymmetrical, margins entire, apex acute to acuminate; petiolules 0.5–0.9(–1.4) cm long, glabrescent to pilose, rarely velutinous. **Inflorescences** to 44 cm long, pendent, sweetly scented; axes often lenticellate, pilose to pilose-villous with short to long, spreading or appressed hairs. **Flowers** 3.5–4.6(–6) mm long; pedicels 0.5–0.75(–1) mm long, usually pilose, occasionally villous; calyx 0.75–1(–1.25) mm tall, glabrescent or pilose outside, lobes imbricate, sepals spatulate, (0.5–)0.75–1 × (0.5–)0.75–1(–1.25) mm, margins shortly ciliate; *petals* white to creamy-white, 3.5–4.9(–5.8) × (1.3–)2–2.6(–3.1) mm, usually glabrescent occasionally pilose outside, *margins shortly ciliate*; androgynophore (1.75–)3.0–4.5(–5.5) mm long; filaments 1.25–2.5 mm long (male flowers), 0.75–1.25(–1.75) mm long (female flowers), glabrous to pilose-villous, anthers 0.5–1.1 × 0.3–0.7(–0.9) mm, apices usually apiculate, often with long appendage, antherodes usually sagittate, 0.5–0.75(–0.9) × 0.3–0.5 mm, often with long apiculate appendage; disc 1.25–1.75(–2.5) mm diameter, reddish orange, pilose; ovary 1.25–1.8 mm diameter, sparsely to moderately pilose, each locule with 5–8 ovules, *style* 1–2.5(–3) mm long, 0.2–0.4 mm diameter (in male flowers), 0.3–1.5 mm long, 0.3–0.5 mm diameter (in female flowers), *glabrous*, stylehead 0.75–1.1(–1.25) mm diameter. **Fruits** 15–20(–28) mm long; columella 13–17(–28) × 6–10 mm, concave with apical scarring; *valves red to reddish brown, smooth to lenticellate with many small* (0.1–0.6 mm diameter) *scattered lenticels*. **Seeds** winged at both ends, 11–19 × 2.5–4.0(–5.8) mm, wings unequal, apices narrowly obtuse; seed body 5–8 mm × 1.1–2.4(–3) mm.

Vernacular names. Sabah—*limpaga* (preferred name), *ranggu* (Dusun).

Distribution. Pakistan, India, Bangladesh, S China, Myanmar, Thailand, Sumatra, Peninsular Malaysia (Kedah, Langkawi, Penang, Perak), Java, Borneo, the Philippines, Sulawesi, Nusa Tenggara, Maluku, New Guinea and New Britain to E Australia. In Borneo, known only in Sabah from Keningau, Kota Kinabalu, Ranau and Sandakan districts (e.g., *SAN 20212*, *SAN 25518*, *SAN 49242*, *SAN 56902* and *SAN 73475*) and in Kalimantan (e.g., *bb. 29226*).

Ecology. It has been planted in some areas of Sabah, but is reported as common to scarce in primary and disturbed, often riparian, rainforests from sea-level to 1000 m altitude.

¹ Note that copies of the IDC microfiche edition seen (K, L, P) are defective in including neither this sheet nor those near it in Herb. Willd.

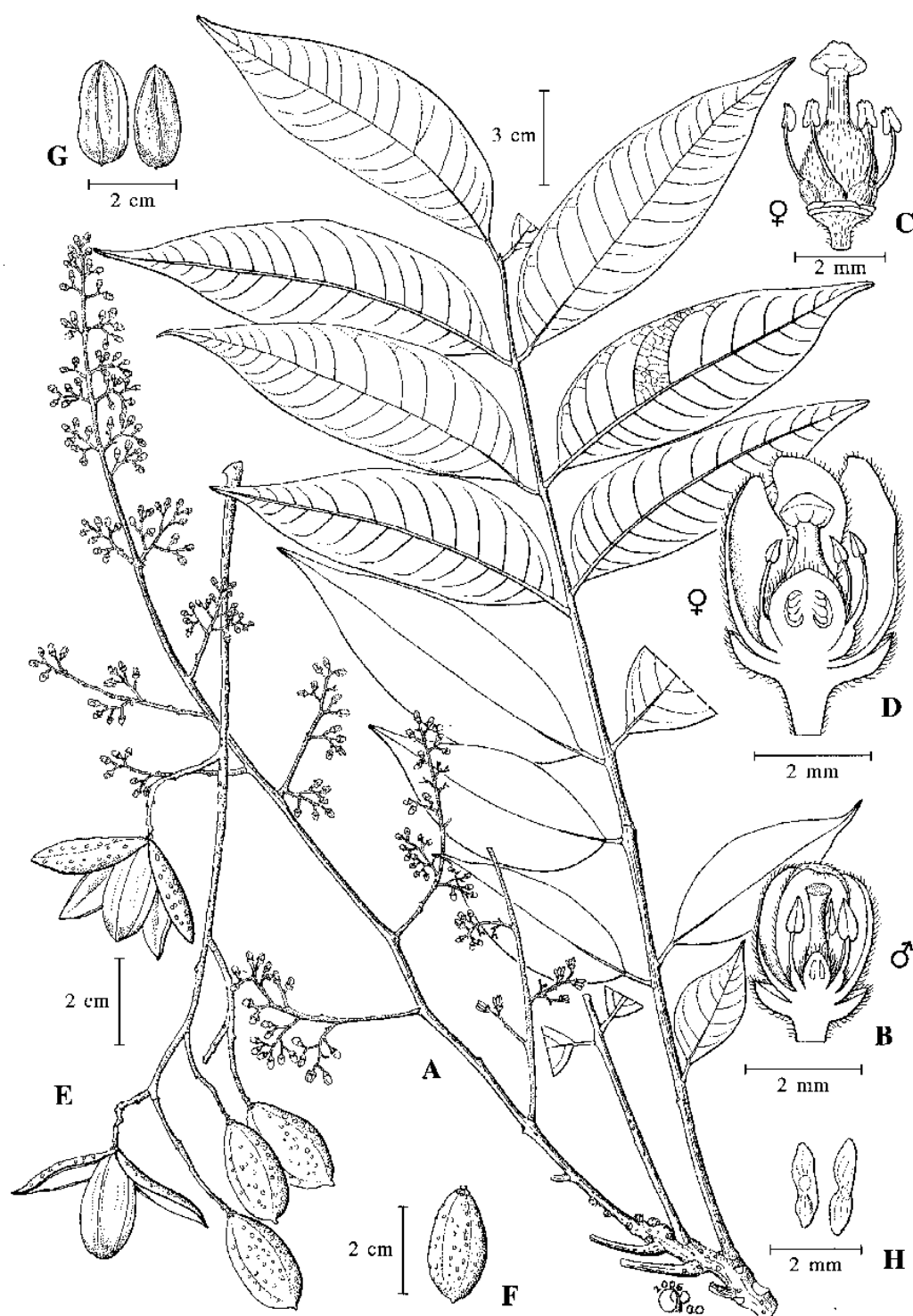


Fig. 30. *Toona ciliata*. A, flowering leafy twig; B, longitudinal section of male flower; C, female flower with sepals and petals removed; D, longitudinal section of female flower; E, infructescence; F, fruit; G, columella; H, seeds. (A–D from SAN 58856; E–H from SAN 20212.)

Uses. The timber is highly valued, especially in India and Australia; it is used in house and boat construction, for high grade furniture and carvings, and to make tea-chests, oil casks, pencils and musical instruments. The flowers are used as a source of red and yellow dyes for silk. Various parts are used medicinally throughout its range; the bark is a powerful astringent, a tonic and an anti-periodic, and is also used to treat dysentery and wounds.

Notes. The recent attempt (Almeida & Almeida, *J. Bombay Nat. Hist. Soc.* 91 [1995] 473) to push aside the well known name *Toona ciliata* in favour of '*T. hexandra* (Wall.) M. Roem.') fails because the epithet '*hexandra*' was not validated until 1846 and *T. hexandra* was first put in the synonymy of *T. ciliata* and not *vice versa*; the supposed basionym, *Cedrela hexandra* Wall. in Roxb., Fl. Ind. 2 (1824) 425, was a *nomen provisorium* and all the new infraspecific names proposed by the Almeidas (*op. cit.*) under '*T. hexandra* (Wall.) M. Roem.' are illegitimate.

This is the most wide-ranging *Toona* species and it exhibits considerable variation in filament pubescence. The type has glabrous filaments and this form extends to Hainan. With a more restricted distribution within this range, are trees with glabrescent or sparsely pilose-villous filaments; extending the range to E Australia are trees with conspicuously villous filaments. Whether the eastern variants should be recognised infraspecifically has yet to be determined. The name '*Toona (Cedrela) velutina* (DC.) M. Roem.' has often been given to specimens that have a dense velutinous pubescence on the vegetative organs. Such a variation in pubescence occurs in nearly all *Toona* species, and can occur within the same population of trees or sometimes even on different parts of the same tree, particularly represented by specimens collected at different seasons.

An important timber tree in the Philippines, occurring at low to medium altitudes in primary forests and commonly known as *T. calantas* Merr. & Rolfe (Philip. J. Sci. C. Bot. 3 (1908) 105), is morphologically similar to *T. ciliata*. It may be a distinct species or merely a large-fruited geographical variant of *T. ciliata*. The fruits are usually (2–)2.8–4 cm long, with the columellas 2.4–4 × 0.7–1.5 cm; the valves are dark red or reddish brown, smooth, 2.4–4.1 × 0.4–1.4 cm, and lenticellate with numerous smallish lenticels (0.1–1 mm diameter), which are often even smaller and denser towards the base of the capsule. The seeds are (14–)20–32 × 3–6 mm with unequal wings broadly obtuse apically and with the seed body 4.2–10 × 1.5–3 mm. Some *Toona* specimens from Sabah might be referable to this large-fruited taxon.

2. *Toona sureni* (Blume) Merr.

(Latinized form of Javanese plant name, *suren*)

Interpr. Rumph. Herb. Amb. (1917) 305, Merrill *op. cit.* (1923) 357; Backer & Bakhuizen *f. op. cit.* 117; Mabblerley *op. cit.* (1989) 258; Edmonds *op. cit.* (1995) 363; PROSEA 5, 2 (1995) 498; Turner *op. cit.* 342; Argent *et al.* (eds.) *op. cit.* 424. **Basionym:** *Swietenia sureni* Blume, Cat. Gew. Buitenz. (1823) 72. **Lectotype** (selected here): Reinwardt *s.n.*, Java (L [Acc. No. 903257725]). **Synonyms:** *Cedrela febrifuga* Blume, Verh. Bat. Gen. 9 (1823) 135, Ridley *op. cit.* (1922) 415; *Cedrela sureni* (Blume) Burkill, Gard. Bull. Str. Settl. 5 (1930) 122, Symington *op. cit.* 122.

Tree to 40 m tall; bole to 25 m tall, with or without buttresses (up to 1 m); crown spreading, occasionally dense. **Bark** grey-brown, grey, light- or dark-brown, usually vertically fissured and flaking; inner bark pinkish white, brown, reddish or orange, fibrous. **Sapwood** cream,

pink or pale red; with cedar-aroma when cut. **Twigs** pilose and often *densely and prominently lenticellate with large fuscous* (= greyish brown), *verrucose* (= warty) *lenticels*. **Leaves** 29–52(–84) cm long; rachises glabrescent to moderately pilose or densely villous/velutinous; petioles 6–10 cm long, glabrescent to pilose, often lenticellate; *leaflets* 7–10(–12) on each side of rachis, *upper surface glabrescent to moderately pilose, (usually with short hairs and club-shaped glands) on the midribs and lateral veins*, lower surface occasionally glabrescent though usually pilose to densely villous/velutinous and fuscous; blades lanceolate to ovate-lanceolate, 6–15.5(–19.5) × 3–5.5(–7) cm, base symmetrical to asymmetrical, margin entire, apex acuminate, occasionally acute; petiolules 0.2–0.5(–1.2) cm long, glabrescent to pilose/villous. **Inflorescences** to 32 cm long, pendent; axes pilose to villous with medium to long spreading hairs, occasionally glabrescent. **Flowers** sweetly aromatic, 4.2–5 mm long; pedicels (0.3)0.75–1(–1.25) mm long, pilose to villous; calyx 1–1.3 mm tall, glabrescent to pilose outside, lobes imbricate, sepals usually shallowly triangular, especially in bud, 0.6–1 × 0.8–1.5 mm, glabrescent to villous outside, apices usually acute, margins ciliate; *petals* white or creamy-white, 3.5–4(–5) × 1.6–2(–3.2) mm, glabrescent to villous outside, but *usually with conspicuous long appressed hairs forming ciliate bands on petal margins* in bud; androgynophore 2.5–3.5(–4.7) mm long; filaments 1–1.75(–2.5) mm long (in male flowers), 1–1.3 mm long (in female flowers), pilose to villous with scattered to dense long hairs, anthers 0.75–1.25 × 0.3–0.4(–0.8) mm, apices often apiculate, antherodes 0.5–0.9 × 0.25–0.6 mm, sagittate; disc 1.25–1.75(–2.5) mm diameter, reddish, densely pilose; ovary 1.6–2.75 mm diameter, moderately to densely pilose, each locule with up to 6-ovules, *style* 0.6–1.5(–3) × 0.25–0.5 mm (in male flowers), 0.5–1 × 0.3 mm (in female flowers), *pilose with scattered usually appressed hairs especially on the lower half*, stylehead 0.6–0.9(–1.25) mm diameter. **Fruits** 14–20(–24) mm long; columella 14–20(–24) × 5–8(–10) mm, concave with apical scarring; *valves dark to blackish brown, rough, verrucose with conspicuous, often ovoid rusty lenticels*, 0.3–2 × 0.4–1.25 mm. **Seeds** winged at both ends, 11–20(–22) × (3–)4–4.8 mm, wings unequal with broadly obtuse apices; seed body 5–8 × 1.5–2 mm.

Vernacular names. Sabah—*limpaga* (Dusun Tambunan), *ranggoh* or *ranggo* (Dusun). Sarawak—*tarak* (Kelabit); Kalimantan—*suren*.

Distribution. India, Nepal, Bhutan, Myanmar, S China, Thailand, Sumatra, Peninsular Malaysia, Java, Borneo, the Philippines, Sulawesi, Lesser Sunda Islands, Maluku and New Guinea. In Borneo uncommon (rarely collected); so far known only from two records from the Kelabit Highlands (teste Noraini photographs) and Bario, Marudi districts (*R. Lian I*) in Sarawak. This species has been much confused with *T. ciliata* to which all Sabah specimens thus named (see above) are here referred. No indigenous Sabah specimen can confidently be placed here.

Ecology. Said to be common to rare in different types of forests, often in logged and disturbed areas, usually on hillsides or slopes often associated with streams or rivers, from sealevel to 1300 m.

Uses. The trees are fast-growing and the timber is favoured for house- and boat-building in Sarawak due to its lightweight properties. Medicinally, the bark is used as a powerful astringent and a purgative throughout its range; in Indonesia it is used as an astringent and a tonic for treating diarrhoea, dysentery and other intestinal infections. Leaf extracts have an antibiotic activity against *Staphylococcus*.

Notes. The original description refers to a fruiting tree and notes the form of the inflorescence, but not the flowers. In Blume's herbarium, there is no fruiting material of the

right date and, indeed, only one sheet bearing his name '*Swietenia surenis* [sic]': this flowering specimen is here chosen as lectotype.

Across its range, this species exhibits a number of large-fruited variants, of which the most striking was described as *Cedrela celebica* Koord. (Med. s'Lands Plant. Batav. 19 (1898) 636) from NE Sulawesi. Its capsules are larger, generally 35–42 mm long, with columellas 29–38 × 13–18 mm; the verrucose valves are 36–41 × 9–11 mm and covered with large rusty lenticels 0.75–1.25 mm diameter; the seeds are 18–29 × 6–9 mm. Whether this is merely a large-fruited variant of *T. sureni* or a distinct taxon remains to be resolved.

13. VAVAEA Benth.

(Vava'u, Tonga)

In Hooker, Lond. J. Bot. 2 (1843) 212; Merrill, Enum. Philip. Fl. Pl. 2 (1923) 359; Backer & Bakhuizen *f.*, FJ 2 (1965) 119; Pennington, Blumea 17 (1969) 351; Pennington & Styles, Blumea 22 (1975) 464; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 234; Mabberley *et al.*, FM 1, 12 (1995) 34; Mabberley, PB 2nd. ed. (1997) 742; Argent *et al.* (eds.), MNDT-CK 2 (1997) 424; PROSEA 5, 3 (1998) 573; Beaman & Anderson, PMK 5 (2004) 134.

Trees or treelets with *Terminalia*-branching. **Indumentum** of simple hairs. **Bud scales** absent. **Leaves** simple. **Inflorescences** axillary or sometimes extra-axillary panicles of cymose branches, rarely subtended by a few subulate reduced leaves. **Flowers** mostly bisexual; calyx 4- or 5(–7)-lobed, with open rarely imbricate aestivation; petals (3 or) 4–6, free, imbricate, rarely contorted; staminal tube cylindrical or cup-shaped; filaments partly free, anthers 9–23, attached at ends of filaments; disc patelliform (= kneecap-shaped) or cup-shaped, united to base of staminal tube, or forming androecial ribbing, or absent; ovary 2–6-locular, each locule with 1 or 2 (rarely 3) collateral ovules or with 4–10 ovules in 2 rows. **Fruit** a berry with fleshy to woody pericarp. **Seeds** 1–3(–7), ovoid or planoconvex, with thin sarcotesta; thin endosperm sometimes present; embryo with planoconvex, collateral cotyledons; radicle superior, small, included or extending to the surface. Germination cryptocotylar; eophylls opposite, simple.

Distribution. Four species from Sumatra to tropical Australia and Polynesia, one restricted to Fiji and two to New Guinea. In Sabah and Sarawak the genus is represented by one species.

Vavaea amicorum Benth.

Fig. 31.

(Latin, *amicorum* = of friends; alluding to Tonga [Friendly Islands])

In Hooker, Lond. J. Bot. 2 (1843) 212; Merrill *op. cit.* (1923) 359; Pennington *op. cit.* 358; Whitmore, Tantra & Sutisna *op. cit.* 234; Mabberley *et al. op. cit.* 35; Argent *et al.* (eds.) *op. cit.* 426; Beaman & Anderson *op. cit.* 134. **Type:** *Barclay s.n.*, Tonga, Vava'u, May 1840 (holotype K). **Synonyms:** *Vitex bantamensis* Koord. & Valeton, Bijdr. Booms. Java 7 (1900) 210; *Vavaea bantamensis* (Koord. & Valeton) Koord. & Merr. *in* Koorders & Valeton, Atl. Baum. Java 2 (1914) err. slip *t.* 298, Backer & Bakhuizen *f. op. cit.* (1965) 120.

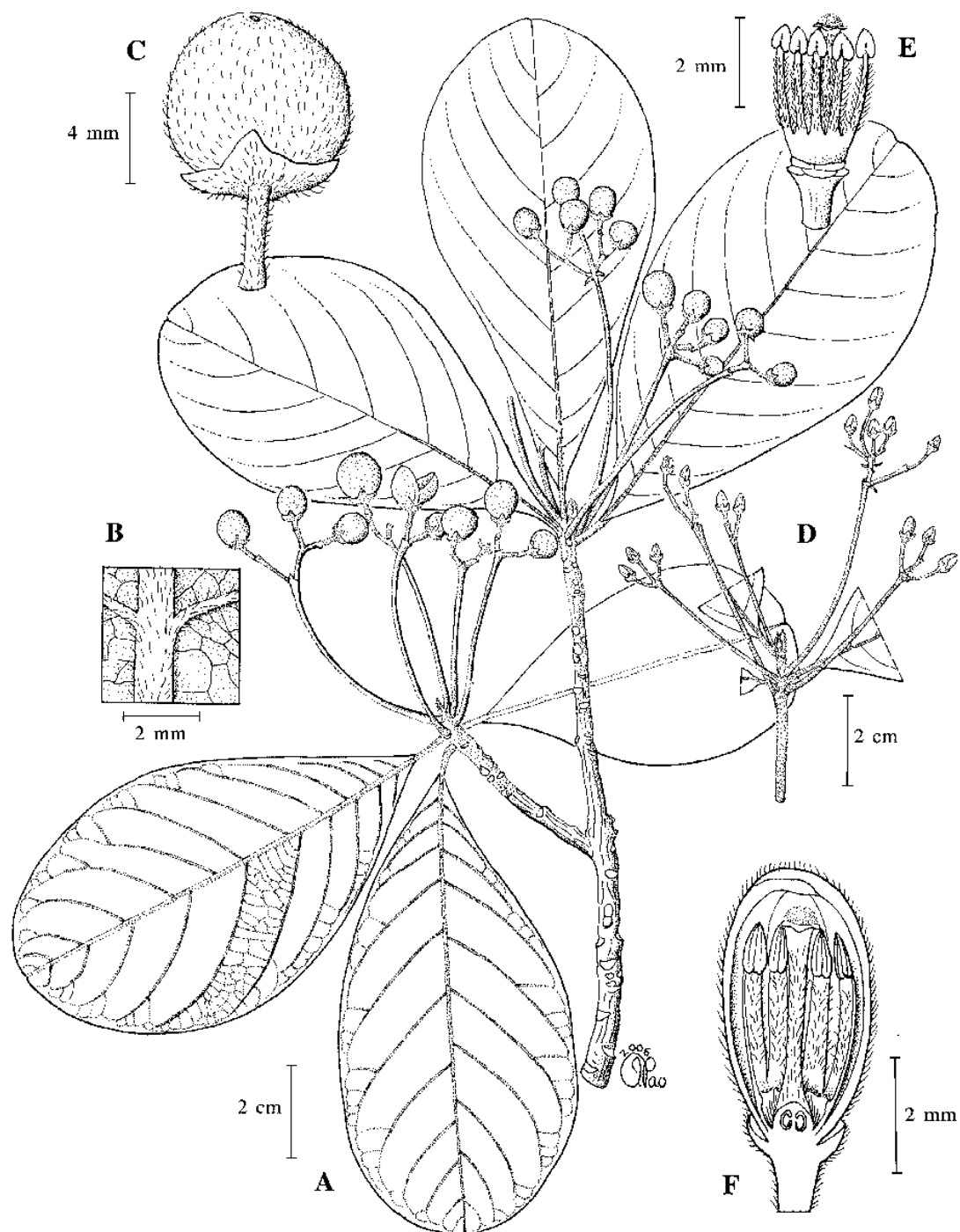


Fig. 31. *Vavaea amicorum*. A, fruiting leafy twig; B, detail of part of lower leaf surface showing fine venation and indumentum; C, fruit; D, flowering leafy twig; E, flower with sepals and petals removed; F, longitudinal section of flower. (A–C from *Keith* 6212, D–F from *FD FMS* 41260 [= *Orolfo* 7125].)

Treelet or tree to 30 m tall, usually much less; bole to 30 cm diameter; buttresses absent, rarely to 3 m tall, 2 m out. **Bark** brown, smooth, lenticellate to scaling, scales 5–10 × 5 mm; inner bark off white. **Sapwood** off white, darkening on exposure. **Twigs** 2–5(–10) mm diameter apically. **Leaves** in terminal rosettes, subglabrous to densely hispid; blades oblanceolate to obovate, rarely orbicular, (2.2–)3–22(–27) × (2–)5–9(–13) cm, base cuneate to attenuate, rarely truncate, apex obtuse, with or without an acute to obtuse acumen, less often more or less truncate; lateral veins 6–11(–16) on each side of midrib; intercostal venation sometimes conspicuously reticulate; petioles (2–)3–22.5(–45) mm long. **Inflorescences** (1.5–)2–13(–15) cm long; axes more or less pubescent; bracts linear-lanceolate, rarely foliaceous 1–4(–40) mm long. **Flowers:** pseudopedicels 1–5 mm long; calyx 1–3.5(–5) mm long, 4–6(–7)-lobed, the lobes deltate, ovate or oblong, with open aestivation, rarely foliaceous and somewhat imbricate at base; petals (3 or) 4–6, oblong to oblanceolate or rarely spatulate, 4–9.5 mm long, rather fleshy, imbricate or rarely contorted; filaments white or pinkish becoming yellow with age, united for 1/5 to almost their entire length, rarely with an apical pair of small lobes; staminal tube cup-shaped or short-tubular, 2–5.5 mm tall, 2.5–3 mm diameter, hirsute distally outside, densely barbate (= with tufts of long weak hairs) at throat, often purplish, anthers 9–17, ovoid or subspherical, rarely elongate, 0.3–1.2 mm long, glabrous or with a few hairs on connective; disc patelliform, cup-shaped or (short-tubular), 0.5–2 mm tall, glabrous to pubescent; ovary 2–4-locular, each locule with 1 or 2 (or 3) collateral ovules, stylehead depressed-capitate. **Fruits** globose, rarely apiculate, 0.8–2 cm diameter, purplish black when ripe; pericarp usually thin and fleshy, rarely thickened and woody. **Seeds** 1–4.

Vernacular names. Sabah—*chendana* (preferred name), *sendana* (Bajau).

Distribution. Sumatra to the Philippines, tropical Australia and Tonga. In Borneo, known only in Sabah from Kuala Penyu, Lahad Datu, Sandakan and Semporna districts (e.g., *FD FMS 41260*, *SAN 26307*, *SAN 97012*, *SAN 126255* and *SAN A 1537*) and in Kalimantan (e.g., *Kostermans 5958* and *de Vogel 1802*).

Ecology. In forests at altitudes to 1250 m, frequently on limestone.

Uses. In Sabah, the timber is used as incense wood and in local burial rites. Considered a substitute for sandalwood in Fiji and the Caroline Islands, the wood is used for house construction, furniture, cabinet work, joinery and interior finishing in the Philippines and Papua New Guinea (*cf. PROSEA op. cit.* 1998).

14. WALSURA Roxb.

(from *wallurse* or *walsura*, the Tamil name for *W. trifoliolata* (A. Juss.) Harms of India)

Hort Beng. (1814) 32, *nom. nud.*; Fl. Ind. ed. Carey, 3 (1832) 386; Hiern *in* Hooker *f.*, Fl. Brit. Ind. 1 (1875) 563, *p.p.*; King, J. As. Soc. Beng. 64, 1 (1895) 82, *p.p.*; Ridley, FMP 1 (1922) 412, *p.p.*; Merrill, Enum. Philip. Fl. Pl. 2 (1923) 399, *p.p.*; PEB (1929) 131, *p.p.*; Backer & Bakhuizen *f.*, FJ 2 (1965) 129; Pennington & Styles, Blumea 22 (1975) 472; Anderson, CLTS (1980) 253, *p.p.*; Mabberley *in* Mabberley & Pannell, TFM 4 (1989) 252, *p.p.*, PB 2nd. ed. (1997) 752, Gard. Bull. Sing. 55 (2003) 195; Clark, Blumea 38 (1994) 257, *in* Mabberley *et al.*, FM 1, 12 (1995) 45; Coode *et al.* (eds.), CLBD (1996) 206, *p.p.*; Argent *et al.* (eds.), MNDDT-CK 2 (1997) 426; PROSEA 5, 3 (1998) 578; Beaman & Anderson, PMK 5 (2004) 134.

Pachycaul to leptocaul trees. **Indumentum** of simple and/or bifid hairs. **Bud scales** absent.

Leaves imparipinnate with 2–5 opposite lateral leaflets on each side of rachis or unifoliate; pseudogemma absent; rachis swollen at insertion of leaflets. **Inflorescences**

axillary thyrses. **Flowers** bisexual or male; calyx 5-lobed; petals 5, free, aestivation imbricate to valvate; androecium of discrete filaments or a 10-lobed tube with truncate to weakly bifid lobes; disc annular; ovary 2(or incompletely 4?)-locular, each locule with 2 collateral ovules, stylehead capitate to cylindrical, sometimes with 2 apical lobes. **Fruit** a 1- or 2(–?4)-seeded berry or 1- or 2-seeded weakly dehiscent capsule; pericarp with thin layer of sclerenchyma, the locules separated by a thin septum. **Seeds** with pre-raphae-funicular aril; endosperm absent; embryo with planoconvex, collateral cotyledons; radicle superior, included or extending to the surface. Germination cryptocotylar; eophylls spirally arranged, simple, entire.

Distribution. Sixteen species from Sri Lanka to the Himalaya and Indo-China through Malesia to New Guinea. In Sabah and Sarawak, the genus is represented by six species and one incompletely known taxon.

Ecology. Lowland and hill forests at altitudes to 1000 m with one species, *W. grandifolia* confined to limestone habitats.

Uses. The timber is used locally for general construction and interior work. In the Philippines, the wood of *W. pinnata* is considered a substitute for ‘guijo’ (*Shorea guiso* (Blanco) Blume) timber.

Key to *Walsura* species (excluding *Walsura* sp. A)

1. Leaflets strongly rugose, to 21(–28) × 10 cm. Filaments almost free...**3. W. grandifolia**
Leaflets not rugose, usually smaller, if not, staminal tube present.....2
2. Twigs 8–15 mm diameter apically. Leaves with 4 (or 5) leaflets on each side of rachis.....**4. W. pachycaulon**
Twigs 2.5–8 mm diameter apically. Leaves with 1–3 leaflets on each side of rachis.....3
3. Leaflet apex with an acumen (2–)2.5–5 cm long.....**6. W. sarawakensis**
Leaflet apex acute or with an acumen to 1.5 cm long.....4
4. Leaflet puberulent to densely pubescent below. Inflorescence a tightly condensed thyrses to 1.7 cm long. Fruits 4-winged to rhomboidal in cross-section, dehiscent.....**2. W. dehiscens**
Leaflet glabrous below. Inflorescence subcorymbose cymes or open thyrses with up to third order branching, 8–35 cm long. Fruits round in cross-section, indehiscent.....5
5. Leaves to 25 cm long; petioles 3–5 cm long; leaflets ovate, lateral ones 5.5–14.5 × 2–4.5 cm. Inflorescences subcorymbose cymes. Fruits brownish green tomentellous, ellipsoid.....**1. W. decipiens**
Leaves to 50 cm long; petioles c. 9 cm long; leaflets narrowly oblanceolate or elliptical-oblong, lateral ones 5.5–25 × 2–11.5 cm. Inflorescences an open thyrses with up to third order branching. Fruits glabrous to finely puberulent, spherical to

ovoid.....5. *W. pinnata*

1. *Walsura decipiens* Mabb.

Fig. 32.

(Latin, *decipiens* = deceiving; an allusion to collectors being led to believe it belonged to Burseraceae, Leguminosae, or Sapindaceae)

Gard. Bull. Sing. 55 (2003) 195. **Type:** *Meijer SAN 36201*, Sabah, Labuk Rd. mile 25.5 (holotype SAN; isotypes K, KEP, L, SAR, SING). **Synonym:** *Walsura pinnata* auct. non Hasskarl (1855): Clark *op. cit.* (1994) 276, *p.p.*, *op. cit.* (1995) 48, *p.p.*

Tree to 28 m tall; bole to 6 m tall, to 30 cm diameter. **Bark** scaly, dark red-brown; inner bark pinkish red. **Young twigs** pale brown, finely sericeous, lenticellate, *older ones 4–5 mm diameter apically*. **Apical buds** strongly fulvous-hairy. **Leaves** to 25 cm long; *petioles 3–5 cm long*, terete; *leaflets glabrous and somewhat glaucous below when dry, lateral ones 2 on each side of rachis; blades ovate, that of lateral leaflets 5.5–14.5 × 2–4.5 cm*, the apicals larger than laterals, articulated at petiolule apices, base acute, *apex acuminate, acumen to 1.5 cm long*; lateral veins 8–12 on each side of midrib, arising almost at right angles to midrib but strongly arcuate, looping together but not reaching margin; petiolules 8–18 mm long, that of apical leaflet to 25 mm long, conspicuously swollen at both ends. **Inflorescences** *subcorymbose cymes to 20 cm long*, in axils of current flush of which apical leaves scarcely developed; axes densely fulvous-pilose; peduncles to 7 cm long, with branches to 9 cm long, bearing apical head of branchlets, each branched once or twice more and bearing cymules of 1–5 flowers; bracts triangular, to 2 mm long, usually much less, densely hairy, caducous. **Flowers:** pedicels *c.* 1 mm long; bracteoles triangular, 0.5–1 mm, densely hairy, persistent; calyx *c.* 0.8 mm tall, green, lobes broadly triangular, apices rounded to acuminate, very hairy outside; petals oblong, *c.* 3 × 1 mm, white, hairy outside, apex obtuse; filaments 10, alternately long and short, the longer ones almost as long as petals, weakly bifid, apically strigose, pale green, anthers ovate, *c.* 0.7 mm long, apiculate, sparsely hairy, bright yellow, inserted between 2 apical lobes; disc fleshy, annular; ovary glabrous, style to 1.2 mm long, stylehead flattened with apical papilla and peripheral flange. **Fruits** *ellipsoid, 2.5–3 cm long, indehiscent, round in cross-section, brownish green tomentellous*, apex usually apiculate. **Seed** 1, ellipsoid.

Distribution. Endemic in Borneo, known only in Sabah from Keningau, Sandakan and Tawau districts (e.g., *SAN 30552*, *SAN 31560*, *SAN 35017*, *SAN 118523* and *SAN 118575*) and in Sarawak from Baram district (e.g., *S 35017*).

Ecology. Rain forest at altitudes to 150 m.

2. *Walsura dehiscens* T.Clark

(Latin, *dehiscens* = splitting open; the fruit)

Blumea 38 (1994) 287, *op. cit.* (1995) 53. **Type:** *Clark 78*, Sarawak, Simunjan district, Sabal FR (holotype L; isotypes FHO [not found], SAR [not found]).

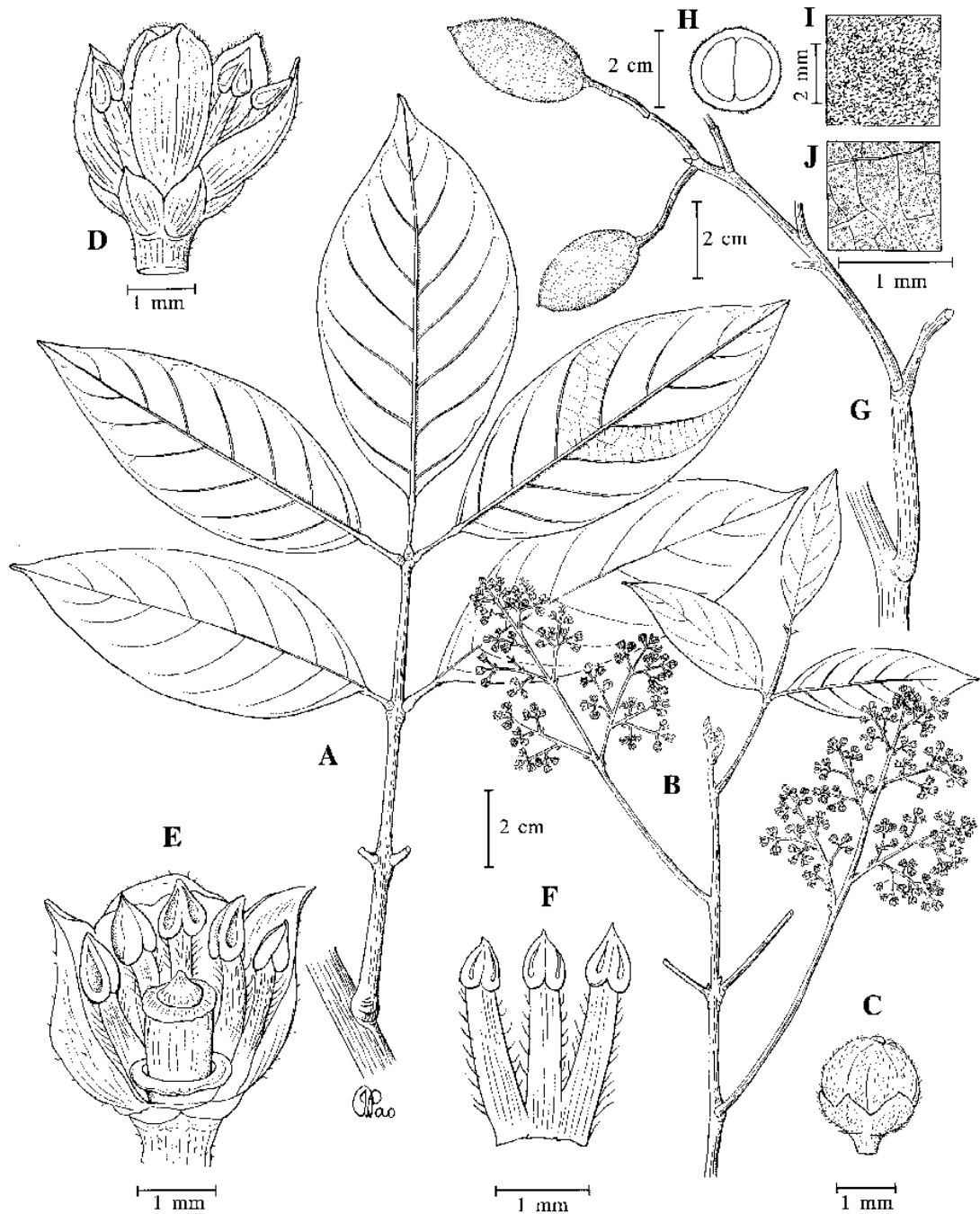


Fig. 32. *Walsura decipiens*. A, leafy twig; B, flowering leafy twig; C, flower bud; D, open flower; E, open flower with some sepals and petals removed; F, adaxial view of stamens; G, fruiting twig; H, cross section of fruit; I, indumentum on fruit wall; J, indumentum on lower leaflet surface. (A from SAN 31560, B–F from SAN 36201, G–J from S 35017.)

Tree to 9(–13) m tall; bole to 8(–12) cm diameter. **Bark** smooth, grey; inner bark pale yellow or pinkish. **Twigs** 1.5–3.5 mm diameter apically, glabrous to puberulous, densely lenticellate, dark brown to blackish. **Leaves** 25–30(–35) cm long; petioles 4.5–9.5 cm long, 1.5–2(–2.5) mm thick, more or less terete, lenticellate; lower surface of leaflets glaucous except on the veins, puberulent to densely pubescent, lateral ones 2 on each side of rachis; blades of terminal and upper lateral leaflets elliptical (to obovate), basal ones ovate to elliptical, (9–)11–16(–19) × 4–6(–8) cm, apex acute with acumen to 1.5 cm long; lateral veins 6–9 on each side midrib; petiolules 0.7–2(–2.5) × 0.6–1.2 mm. **Inflorescences** tightly compact thyrses, 1–1.7 cm long, 1(or 2)-branched, branches to 4 mm long, all densely hairy. **Flowers:** buds cylindrical, 1.5–1.6 × 1.2–1.3 mm; calyx 1–1.4 mm tall, lobes c. 0.6 mm; petals 2.2–2.5 × 1–1.8 mm, glabrous inside; androecium c. 1.5 mm tall, cylindrical to barrel-shaped, tubular in the lower 1/5, filaments pubescent on edges, apically bifid, teeth c. 0.2 mm long, anthers c. 0.5 mm long, shortly beaked; disc c. 0.4 mm tall; style c. 0.5 mm long, 0.5 mm diameter, below bilobed stigmatic surface c. 0.9 mm diameter. **Fruit** a 1- or 2-seeded capsule, 4-winged when immature, rhomboidal to subterete in cross-section, 1.7–1.5 × 0.6–0.9 cm, subglaucous when fresh, brown when dry, puberulous, weakly septically dehiscent into 2(–?4) valves. **Seeds** with white fleshy coat.

Vernacular names. Sarawak—*penyan-ketidoh* (Punan).

Distribution. Endemic in Borneo and known in Sabah from Beaufort, Kota Kinabalu and Papar districts (e.g., *SAN* 33572, *SAN* 47852 and *SAN* 78228) and in Sarawak from Belaga, Limbang, Lubok Antu, Miri, Serian, Sibuan, Simunjan and Sri Aman districts (e.g., *Geh & Samsuri* 1105, *S* 16648, *S* 40128, *S* 43064, *S* 63391 and *S* 83356). Also occurring in Kalimantan (e.g., *Hallier* 355, *Kostermans* 10324 and *Winkler* 2414) but not yet recorded from Brunei.

3. *Walsura grandifolia* Ridl.

(Latin, *grandis* = large, *folium* = leaf; large-leaved)

Bull. Misc. Inform. Kew (1930) 370; Anderson *op. cit.* (1980) 253; Mabberley, Gard. Bull. Sing. 55 (2003) 198. **Type:** *Haviland* 1635, Sarawak, near Kuching, 5 Oct 1892 (holotype K; isotype SAR). **Synonym:** *Walsura pinnata* auct. non Hasskarl (1855): Clark *op. cit.* (1994) 276, *p.p.*, *op. cit.* (1995) 48, *p.p.*

Treelet to 7 m tall; trunk to 10 cm diameter. **Bark** smooth, greyish white; inner bark brown. **Twigs** 7–8 mm diameter apically, lenticellate. **Leaves** c. 40 cm long, glabrous; petioles 10–15 cm long, flattened adaxially; leaflets coriaceous, strongly rugose, lateral ones 2 on each side of rachis; blades elliptical to elliptical-oblong (apical one obovate), to 28 × 10 cm, base cuneate, apex shortly acuminate; lateral veins 12–15 on each side of midrib, impressed above, prominent below; petiolules 2–2.3 cm long (of apical leaflet to 5.5 cm long), stout. **Inflorescences** to 35 cm long, lax; peduncles c. 15 cm long, branches remote, basal ones c. 8 cm long, apical ones c. 2.5 cm long, few-flowered, puberulous; bracts small, lanceolate, pubescent, caducous. **Flowers:** pedicels c. 2 mm long, pubescent; calyx c. 1 mm tall, pubescent, green, 5-lobed, the lobes subtriangular, acute; petals oblong-ovate, 3.5–4 × 1–1.5 mm, pubescent outside, fleshy, green; filaments almost free, c. 0.5 mm wide, unlobed, pubescent especially on margins, anthers c. 0.8 mm long, strongly apiculate, apically hairy, inserted apically; disc torus-shaped, c. 0.5 mm tall, glabrous; ovary densely pilose, style swollen towards apex, stylehead cylindrical, c. 0.6 mm across, glabrous. **Fruits** (immature) yellow-orange, covered with very fine brownish hairs. Aril juicy, transparent.

Distribution. Endemic in Borneo and restricted to Bau and Kuching districts, Sarawak (e.g., *S* 32633, *S* 41069, *S* 50390 and *S* 74985).

Ecology. Forest on limestone at altitudes to 200 m. Rarely collected.

Notes. Recently confused with *W. pinnata* from which it differs in its very large leaflets and flowers, its androecium of almost free filaments without apical teeth, its larger disc and its longer cylindrical stylehead.

4. *Walsura pachycaulon* Mabb. ex T. Clark

Fig. 33.

(Greek, *pachy-* = thick, *caulos* = stem; referring to the thick leafy shoots)

Blumea 38 (1994) 280, *op. cit.* (1995) 51; Coode *et al.* (eds.) *op. cit.* 207. **Type:** *Meijer SAN 53580*, Borneo, Sabah, Sandakan district, Lungmanis FR (holotype L; isotypes K, SAN, SAR, SING).

Tree to 29 m tall; bole to 25 cm diameter. **Bark** grey-brown to blackish; inner bark pink. **Twigs** 8–15 mm diameter apically, lenticellate, glabrous. **Leaves** to 60 cm long; petioles to 22 cm long, 7 mm thick, flattened to channelled adaxially; *leaflets* subcoriaceous, sparsely pubescent or glabrous below, *lateral ones* 4 (or 5) on each side of rachis; *blades* narrowly oblanceolate to elliptical or oblong, 13–19.5 × 3.5–6.5 cm (distal pairs), basal pairs smaller, terminal pairs larger, base somewhat cuneate, apex acuminate; venation prominent on both surfaces; lateral veins 10–19 on each side midrib (terminal leaflets), 9–14 (lateral leaflets); petiolules to 2.3 cm long, to 2 mm thick. **Inflorescences** to 45 cm long, in axils of caducous undeveloped leaves, puberulous, branched to three orders, first order to 15 cm long. **Flowers:** pedicels 1–2.5 mm long; buds *c.* 3 mm diameter before anthesis; calyx *c.* 1.3 mm tall, lobes *c.* 0.5 mm; petals *c.* 4.2 × 2.2, imbricate; *androecium cylindrical*, *c.* 2.4 mm tall, *forming glabrous tube in lowermost ¼*, filaments pubescent on inner surface, apex bifid, anthers *c.* 0.6 mm long, apex shortly beaked and pubescent; disc *c.* 0.7 mm tall, glabrous, style narrowly obconical, glabrous, stylehead *c.* 0.4 × 0.9 mm, apex domed. **Fruits** spherical, to 4.2 cm diameter, brown. **Seeds** to 2.8 × 1.6 cm, with sweet-tasting aril.

Distribution. Endemic in Borneo. In Sabah, known from Kinabatangan, Lahad Datu and Tawau districts (e.g., *SAN* 65826, *SAN* 69355, *SAN* 113497 and *SAN A* 4050) and in Sarawak from Kapit district (e.g., *S* 28266). Also occurs in Brunei (e.g., *Hansen 1566*) and Kalimantan (e.g., *Kostermans 4421*).

Notes. Specimens *SAN* 142584 (from Tawau) and *SAN* 143514 (from Lahad Datu) key out here, though these collections have small leaflets and the buds are fulvous-tomentose. Clark (*op. cit.* 1994), included specimens *S* 21733, *S* 21920, *S* 29617 and *S* 43853 (all collected from small trees to 4 m tall, some on basalt, from Kapit district, Sarawak) in this species. They are, however, not canopy trees and do not have the thick stems typical of the species. They resemble some forms of *W. pinnata* and need further study. Likewise, the correct identity of other specimens (e.g., *SAN* 96172 and *SAN* 100304) collected from small trees (with large leaflets to 30 cm long) in Tawau, Sabah and referred to *W. pinnata* by Clark (*op. cit.* 1994), also need further investigation.

5. *Walsura pinnata* Hassk.

(Latin, *pinnatus* = feather-like; the leaf)

Retzia 1 (1855) 147; Backer & Bakhuizen *f. op. cit.* 129; Anderson *op. cit.* (1980) 253; Mabberley *op. cit.* (1989) 254; Clark *op. cit.* (1994) 276, *p.p.*, *op. cit.* (1995) 48, *p.p.*; Turner, Gard. Bull. Sing. 47 (1995) 343; PROSEA 5, 3 (1998) 579; Beaman & Anderson *op. cit.* 134. **Neotype** (Clark, 1994): *Koorders 971*, Java, Bogor, tree no. III b 20 [grown from material collected by Hasskarl, Java, south Bantam, 1841], 26 June 1892 (BO; 'clonotype' *Anon. s.n., idem*, L [Acc. 926258685]). **Synonym**: *Walsura neurodes* Hiern *op. cit.* 564, King *op. cit.* 84, Ridley *op. cit.* (1922) 412; *Walsura villamilii* Merr., Phil. J. Sci. 9, Bot. (1914) 308, *op. cit.* (1923) 380, *op. cit.* (1929) 132, Masamune, EPB (1942) 377.

Tree, 12–37 m tall; bole 11–24 m tall, 24–38 cm diameter. **Bark** smooth, pale, scaling; inner bark pink-brown. **Twigs** 2.5–8 mm diameter apically, glabrous, usually lenticellate. **Leaves** to 50 cm long; petioles to 9 cm long, 1–4 mm thick, flattened adaxially, usually glabrous; leaflets subcoriaceous, lower surface glabrous or almost so and glaucous (when fresh), lateral ones 2 or 3 on each side of rachis; blades narrowly oblanceolate, elliptical to oblong, lateral ones 5.5–25 × 2–11.5 cm, terminal ones slightly larger, base somewhat cuneate, apex acute to shortly acuminate, acumen to 1.5 cm long; lateral veins 7–12(–20) on each side of midrib, sometimes with shorter veins in between not reaching margin; petiolules 0.4–1.4 cm long. **Inflorescences** thyrsoid, 8–20(–35) cm long, usually in axils of caducous, undeveloped leaves, branched to three orders; primary branches to 10 cm long, puberulous. **Flowers**: pedicels to 2 mm long; buds cylindrical prior to anthesis; calyx 1.2–1.5 (1–9) mm tall, puberulous outside; petals 3–3.8(–4) × 1.5–1.8 mm, imbricate; androecium subcylindrical, with subglabrous tube for about half its length, filaments densely pubescent especially inside, apex bifid with teeth c. 0.2 mm long, anthers 0.6–0.8 mm long; disc 0.2–0.4 mm tall; ovary usually hairy, style more or less cylindrical, glabrous, stylehead c. 0.4 × 0.7–1 mm. **Fruit** a 1- or 2-seeded, indehiscent berry, spherical to ovoid, 1.2–2.4(–2.8) × 1.2–2.4 cm, round in cross-section, glabrous to finely puberulous, reddish when fresh. **Seed** ellipsoid, 1.3–2.3 × 0.9–1.3 cm; aril sweet-tasting, colourless.

Vernacular name. Sabah—*lantupak mata kucing* (preferred name).

Distribution. From S China (Yunnan), Vietnam, Myanmar and Thailand to Peninsular Malaysia, Java, Borneo, the Philippines, Maluku (Halmahera, Aru) and Irian Jaya. In Borneo, recorded in Sabah (but see below) from Beaufort, Keningau, Kinabatangan, Kota Belud, Lahad Datu, Ranau, Sandakan, Semporna, Sipitang and Tawau districts (e.g., *SAN 17583*, *SAN 35188*, *SAN 72681*, *SAN 84004* and *SAN 95758*) and in Sarawak from Kapit and Lundu districts (e.g., *S 23939* and *S 23959*). Also occurring in Brunei (e.g., *FD FMS 34472*) and Kalimantan (e.g., *Mogea 4163*).

Ecology. Lowland rain forest though precise range unclear (see below).

Notes. Clark (1994: 249, 279) discusses the variation in this species and has informal entities for the major variants he recognises. In Sabah, there are typical 'pinnata' (e.g., *SAN 86994*) and also 'villamilii' (e.g., *SAN 57288*), which has leaves with three or four as opposed to two leaflets on each side of rachis with some lateral veins failing to reach the leaf margin, but otherwise, according to Clark, they intergrade. Although there is a wide range of lateral vein number in the leaflets of Sabah specimens, the great majority fall into his broadly circumscribed *W. pinnata*, though specimens with a very small number of lateral

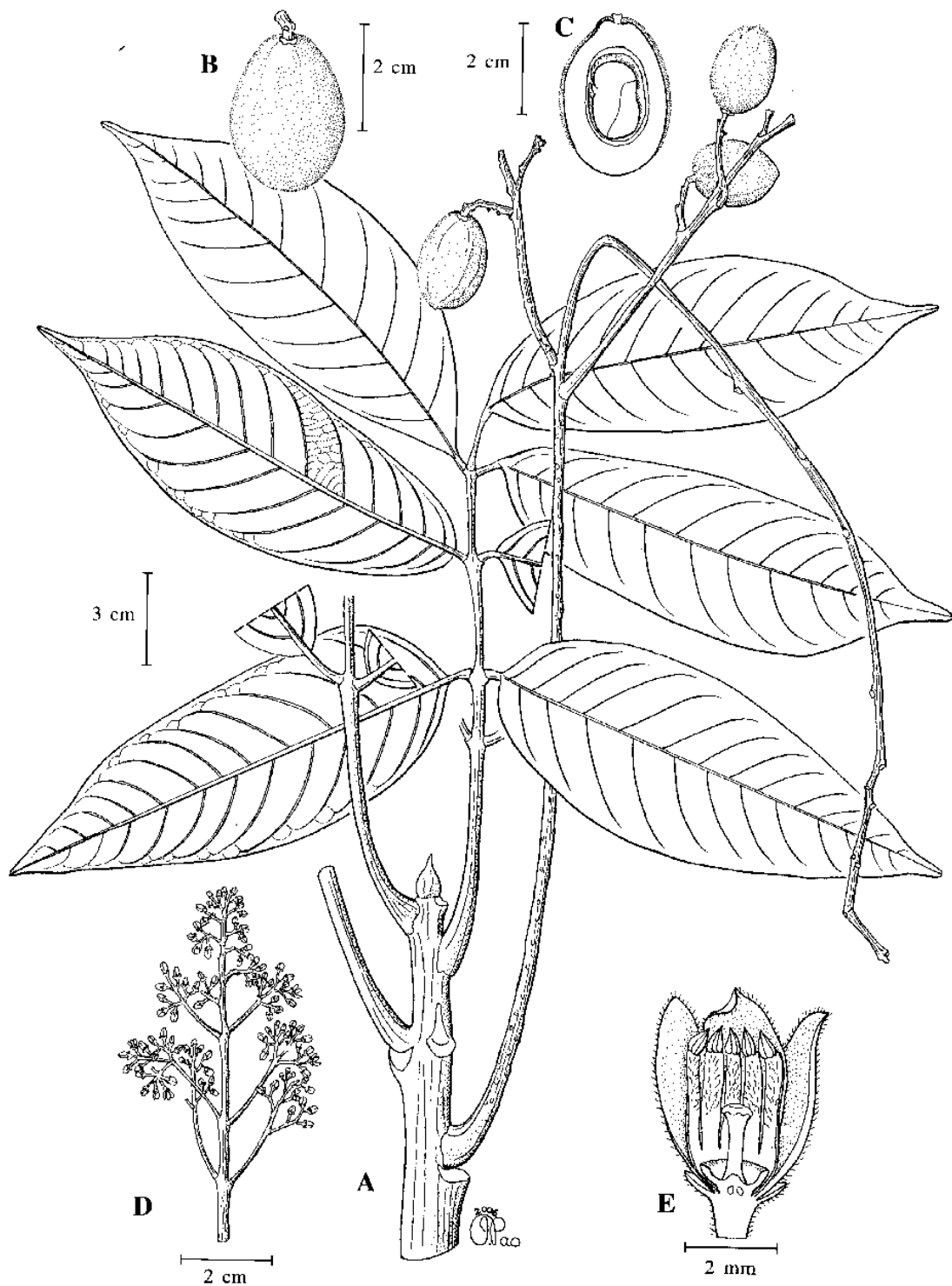


Fig. 33. *Walsura pachycaulon*. A, fruiting leafy twig; B, fruit; C, longitudinal section of fruit; D, distal part of inflorescence; E, longitudinal section of flower. (A–C from SAN 69355, D–E from SAN A 4050.)

veins (6 or 7 on each side of midrib as opposed to 14–19) and short inflorescences and infructescences (e.g., *Mabberley 1664*, *SAN 30551*, *SAN 31339*, *SAN 35168* and *SAN 44553*) seem very distinctive. In Sarawak, ‘typical’ *W. pinnata* has rarely been collected (e.g., *Pennington 8000* with 6–8 lateral veins on each side of midrib and *S 64519* with 18–19 lateral veins). Some of the specimens referred to *W. pinnata* by Clark are now referred to *W. decipiens* and *W. grandifolia* (see above). Nonetheless, even shorn of these and other extraneous materials (see *Mabberley op. cit.* 2003), *W. pinnata* seems to me still to be heterogeneous, more so when the Kalimantan and Peninsular Malaysian materials included herein by Clark are taken into consideration (see also discussion under *W. pachycaulon* above). This perplexing complex still needs further collecting and analysis in the field across its supposed range.

6. *Walsura sarawakensis* T.Clark (from Sarawak)

Blumea 38 (1994) 283, *op. cit.* (1995) 52. **Type:** *Purseglove P 5204*, Borneo, Sarawak, Bt. Mayeng (holotype SING; isotype L).

Treelet, 2–6 m tall. **Twigs** 6–8 mm thick apically, glabrous, pale brown, sparsely lenticellate. **Leaves** 52–80 cm long; petioles 15–21 cm long, flattened adaxially, subglabrous; leaflets subcoriaceous, sparsely pubescent below, lateral ones 3 on each side of rachis; blades lanceolate, to $36(-41) \times 12$ cm, terminal largest, base shortly attenuate, apex acuminate with acumen to 5 cm long; lateral veins 14–18 on each side of midrib, prominent on both surfaces. **Inflorescences** 7.5–8 cm long, in axils of undeveloped leaves, branched to second order, lower branches to 1.3 cm long, puberulous. **Flower buds** cup-shaped before anthesis; calyx c. 1.1 mm tall, lobes c. 0.8 mm long; petals $3.2-3.5 \times 1.7-1.8$ mm, imbricate, green; androecium cylindrical forming a tube in the lower $\frac{1}{2}$ to $\frac{3}{4}$, alternate filaments slightly shorter, apices bifid, the teeth c. 0.3 mm long, anthers c. 0.8 mm long, apex acute to beaked; disc c. 0.3 mm tall; style cylindrical, glabrous, stylehead subcapitate, c. 0.7×1.1 mm. **Fruit** a berry, ellipsoid, $2-3 \times 1.7-2.5$ cm, glabrous, purplish brown. **Seeds** 1–4, $1.8-2.3 \times 1.4$ cm; aril white, sticky.

Distribution. Endemic in Borneo and restricted to Bt. Mersing and Tau Range, Kapit district, Sarawak (e.g., *Purseglove P 5143* and *Purseglove P 5219*). Rarely collected.

Ecology. Lowland forest, at altitudes to 300 m.

Incompletely known species

Walsura sp. A

Clark, *Blumea* 38 (1994) 290, *op. cit.* (1995) 55.

Tree to 35 m tall; bole to 75 cm diameter; buttressed to 1.2 m tall. **Bark** smooth to flaking, reddish. **Twigs** 2.5–4 mm diameter apically, glabrous, lenticellate. **Leaves** 13–24 cm long; petioles 2.5–5 cm long, slightly flattened adaxially near base, densely puberulous with simple and 2-armed trichomes; leaflets subcoriaceous, lateral ones 2 on each side of rachis; blades elliptical, $7.5-14 \times 3.5-5.5$ cm, the apical ones the largest, base acute, apex shortly acuminate; midrib and lateral veins prominent below, sparsely pubescent (simple and 2-armed trichomes); lateral veins 7–10 on each side of midrib; petiolules to 1.2 cm long.

Flowers unknown. **Fruit** a 1- or 2-seeded berry, ellipsoid, 2.2–2.6 × 1.5–1.8 cm, puberulous with simple and 2-armed trichomes. **Seeds** 1–1.5 cm long; aril sweet-tasting, fleshy.

Distribution. Endemic in Borneo and known only in Sarawak from Bintulu and Kuching districts (e.g., *S* 27213, *S* 27982, *S* 30670 and *S* 37776).

Notes. The indumentum comprising simple and 2-armed trichomes is distinctive.

15. XYLOCARPUS J.König

(Greek, *xulon* = wood, *karpon* = fruit; referring to the woody fruit)
nyireh (ASEAN standard trade name)

Naturf. 20 (1784) 2; Merrill, Enum. Philip. Fl. Pl. 2 (1923) 258; Backer & Bakhuizen *f.*, FJ 2 (1965) 118; Pennington & Styles, Blumea 22 (1975) 525; Anderson, CLTS (1980) 253; Mabberley, Mal. For. 45 (1982) 448, *in* Mabberley & Pannell, TFM 4 (1989) 258; Whitmore, Tantra & Sutisna, CLK 2, 1 (1990) 235; Mabberley *et al.*, FM 1, 12 (1995) 371; Coode *et al.* (eds.), CLBD (1996) 207; Argent *et al.* (eds.), MNDDT-CK 2 (1997) 426; PROSEA 5, 3 (1998) 591. **Synonym:** *Carapa auctt. non-Aublet* (1775): Hiern *in* Hooker *f.*, Fl. Brit. Ind. 1 (1875) 566, King, J. As. Soc. Beng. 64, 1 (1895) 87, Ridley, FMP 1 (1922) 414, Corner, WSTM 3rd. ed., 2 (1988) 497.

Semi-evergreen coastal trees. **Twigs** lenticellate, marked with distinct petiole scars. **Indumentum** of simple hairs. **Bud scales** present. **Leaves** paripinnate, without pseudogemmula; leaflets opposite, entire, glabrous, 1–5 on each side of rachis. **Inflorescences** thyrsoid, axillary. **Flowers** unisexual; calyx 4-lobed to about the middle, valvate; petals 4, contorted and much longer than the calyx in bud; staminal tube margin with 8 suborbicular, retuse or shallowly and irregularly divided lobes, anthers 8, included; disc cushion-shaped, substanding or surrounding and united with ovary, red; ovary 4- or 5-locular, each locule with 3 or 4(–6) ovules, style short, stylehead discoid, its margin crenellate (= finely crenate) and its upper surface with four radiating stigmatic grooves. **Fruit** a large pendulous subspherical capsule, tardily dehiscent by 4 (or 5) leathery valves from apex. **Seeds** 5–20, large, irregularly tetrahedral or pyramidal, outermost surface convex, attached to central columella, with aerenchymatous (?sarcotestal) coat; endosperm absent; embryo with the large cotyledons fused together; radicle lying above the hilum. Germination cryptocotylar; eophylls simple, entire, becoming trifoliate later.

Distribution. Three species throughout the coastal regions of the Old World tropics from E Africa to the W Pacific. Two species occurring in Sabah and Sarawak, though there is a single sterile specimen of *Xylocarpus rumphii* (Kostel.) Mabb. (*FD FMS* 35386), collected from Timbun Mata Island, Semporna district, Sabah in 1938. *Xylocarpus rumphii* is not a mangrove tree but grows on beaches and rocky headlands; it has fissured rather than peeling bark and it has more (and more acute) leaflets and larger inflorescences than either of the other two species. If the record is confirmed, it is a first for Borneo.

Ecology. In mangrove swamps and coastal forests on rock and other substrates.

Uses. The wood of *Xylocarpus* spp. is used mainly for high quality furniture, cabinet work, carving and the manufacture of artistic articles. Other common uses include light

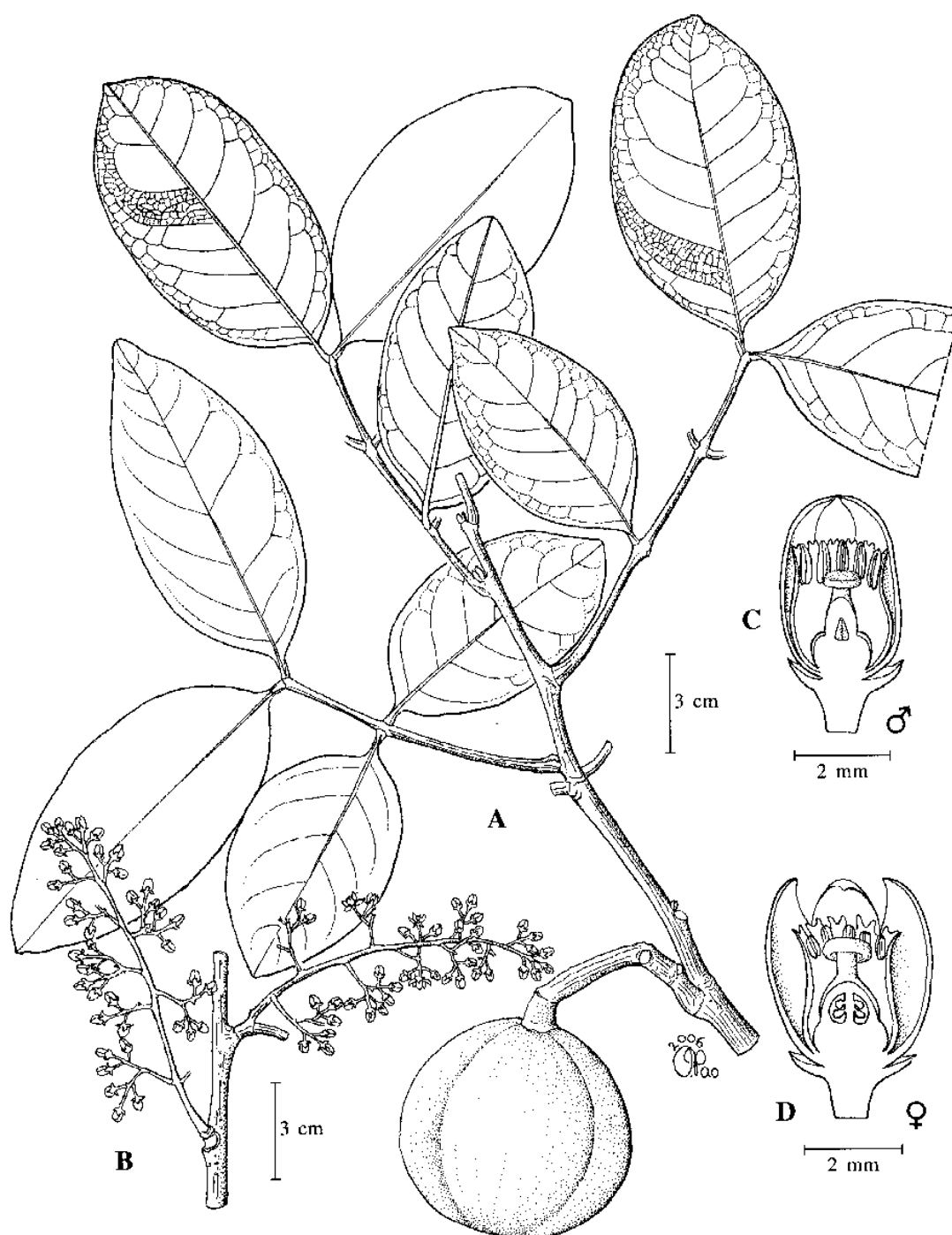


Fig. 34. *Xylocarpus moluccensis*. A, fruiting leafy twig; B, part of inflorescence; C, longitudinal section of male flower; D, longitudinal section of female flower. (A from SAN 84119, B–D from S 36068.)

construction, interior finishing, panelling, flooring and decorative veneer. The bark yields tannin, which has been extensively used to tan fishing nets and hides. Oil extracted from seeds is used as illuminant and for treating insect bites. Decoction of the bark is used in traditional medicine for the treatment of cholera, dysentery, diarrhoea and other abdominal pains. (PROSEA 5, 3 (1998) 591). The antifilarial activity of *Xylocarpus* extracts is discussed by Abdullah *et al.*, J. Trop. For. Prod. 3 (1997) 216–9 and Zaridah *et al.*, J. Ethnopharm. 78 (2001) 79–84.

Notes. The two species definitely occurring in Sabah and Sarawak are most readily distinguished in the field and collectors have so far reported no intermediate specimens. In Peninsular Malaysia, moreover, the local people have separate names for the two, which are frequently confused by herbarium workers. Indeed, in the absence of ecological information, ripe fruit, details of the bark, buttresses and pneumatophores, all of which are distinguishing field characters, the herbarium worker may well be at a loss to pigeon-hole specimens, particularly sterile material, and those from young plants may be almost impossible to determine.

Key to *Xylocarpus* species

Leaflets ovate-elliptical, usually rounded at apex. Inflorescences 1–6 cm long, often with indistinct main axis; pedicels conspicuously swollen near calyx. Fruits 12–25 cm diameter. Buttresses flattened, ribbon-like spreading across mud; pneumatophores absent..... **1. *X. granatum***

Leaflets elliptical-oblong, lanceolate or oblanceolate, apex acute to obtuse. Inflorescences 3–8(–13) cm long, usually with distinct main axis; pedicels not conspicuously swollen near calyx. Fruits 6–11 cm diameter. Buttresses not ribbon-like; pneumatophores erect, pointed..... **2. *X. moluccensis***

1. *Xylocarpus granatum* J.König

Plates 5D & E.

(Latin, pomegranate (*Punica granatum* L., Lythraceae); alluding to the fruit shape)

Naturf. 20 (1784) 2; Merrill, EB (1921) 318, *op. cit.* (1923) 358, PEB (1929) 120; Masamune, EPB (1942) 377; Backer & Bakhuizen *f. op. cit.* 118; Anderson *op. cit.* (1980) 253; Mabberley *op. cit.* (1982) 450, *op. cit.* (1989) 260; Whitmore, Tantra & Sutisna *op. cit.* 235; Mabberley *et al. op. cit.* 378; Turner, Gard. Bull. Sing. 47 (1995) 343; Coode *et al.* (eds.) *op. cit.* 207; Argent *et al.* (eds.) *op. cit.* 426; PROSEA 5, 3 (1998) 594. **Type:** not traced. **Synonyms:** *Carapa moluccensis* auct. non Lam. (1785); Ridley *op. cit.* (1922) 414, *p.p.*; *Carapa obovata* Blume, Bijdr. Fl. Ned. Ind. 1 (1825) 179, King *op. cit.* 87, Ridley *op. cit.* (1922) 414, *p.p.*; *Granatum obovatum* (Blume) Kuntze, Rev. Gen. Pl. 1 (1891) 110; *Carapa granatum* (Koenig) Alston in Trimen, Handb. Fl. Ceylon 6 (1931) 45 '*granata*', Corner *op. cit.* (1988) 497; *Xylocarpus minor* Ridl., Bull. Misc. Inform. Kew (1938) 289, Masamune *op. cit.* 377.

Tree or shrub, (1–)6–15(–20) m tall; bole to 90 cm diameter, often of poor form; *buttresses thin, branched, ribbon-like, spreading out from base; pneumatophores absent.* **Bark** thin, smooth, scaling as irregular flakes, whitish to yellow-brown; inner bark reddish or pink. **Leaves** to 9(–12) cm long, usually much less; petioles to 4 cm long; leaflets coriaceous, 1–3 on each side of rachis; *blades ovate or elliptical*, (3.5–)5–12 × (2–)3–6 cm, base cuneate, *apex rounded or obtuse*; venation prominent on both surfaces; petiolules (2–)5–6(–11) mm long, swollen. **Inflorescences** (1–)3–6 cm long, more or less squarrose, borne on new and older twigs, *frequently forked with indistinct main axis*; bracts and bracteoles *c.* 0.5 mm,

caducous. **Flowers:** *pedicels* 3–9 mm long, *conspicuously swollen towards the calyx*; calyx lobes 1–3 mm long; petals oblong, 3.5–5.5(–6.5) × 2–3 mm, creamy-white or pinkish; staminal tube 2–3.5 mm diameter, lobes apiculate or bifid to retuse. **Fruits** depressed globose, 12–25 cm diameter. **Seeds** 8–16(–20), 4–6 cm long.

Vernacular name. Sarawak—*nyireh bunga* (Iban, Malay).

Distribution. Old World Tropics from E Africa and continental Asia throughout Malesia to Tonga. In Borneo, known in Sabah from Beaufort, Kinabatangan, Kota Kinabalu, Kuala Penyu, Kudat, Labuk Sugut, Lahad Datu, Sandakan, Semporna, Sipitang and Tawau districts (e.g., *Mabberley 1674*, *Pennington 7892*, *SAN 86409*, *SAN 105235* and *SAN 145862*) and in Sarawak from Kuching, Lawas, Sarikei and Sibu districts (e.g., *S 2012*, *S 7744*, *S 26706* and *S 26817*). Also occurring in Brunei (e.g., *BRUN 5058*) and Kalimantan (e.g., *Ambriansyah 2320*).

Ecology. Mangroves, usually estuarine and often associated with *Nypa* and *Sonneratia*.

2. *Xylocarpus moluccensis* (Lam.) M.J.Roem.

Fig. 34.

(from the Moluccas = Maluku)

Syn. Hesp. 1 (1846) 124; Merrill *op. cit.* (1921) 318, *op. cit.* (1923) 358; Backer & Bakhuizen *f., op. cit.* 118, *p.p.*; Anderson *op. cit.* (1980) 253; Mabberley *op. cit.* (1982) 450, *op. cit.* (1989) 260; Whitmore, Tantra & Sutisna *op. cit.* 235; Mabberley *et al. op. cit.* 376; Turner *op. cit.* 343; Argent *et al.* (eds.) *op. cit.* 426; PROSEA 5, 3 (1998) 594. **Basionym:** *Carapa moluccensis* Lam., Enc. Méth. 1 (1785) 621, Hiern *op. cit.* 567, King *op. cit.* 87, Ridley *op. cit.* (1922) 414, *p.p.*, Corner *op. cit.* (1988) 498. **Type** [icon]; Rumphius, *Herb. Amboin.* 3 (1743) t. 61. **Synonyms:** *Granatum moluccense* (Lam.) Kuntze *op. cit.* 110; *Carapa obovata* auct. non Blume (1825); King *op. cit.* 87, *p.p.*, Ridley *op. cit.* (1922) 414, *p.p.*; *Carapa borneensis* Becc., Nelle For. Borneo (1902) 574.

Tree, 6–18(–30) m tall, *with small, not ribbon-like buttresses and many pointed pneumatophores*; bole usually solitary, to 70 cm diameter. **Bark** rough with longitudinal fissures, falling as oblong flakes. **Leaves** to 10 cm long, sometimes with persistent apical spike to 1 mm long; *leaflets* 1–4 on each side of rachis; *blades elliptical-oblong or lanceolate to oblanceolate*, (5–) 7–10(–17) × (2.5)4–6.5(–7) cm, base cuneate, more or less asymmetrical, *apex acute to obtuse*; venation prominent on both surfaces; petiolules (0–)2–5 mm long, sometimes swollen. **Inflorescences** 3–8(–13) cm long, often produced with the new leaves, somewhat lax, *main axis distinct*; lateral branches to 4 cm long; bracts and bracteoles *c.* 0.5 mm, more or less persistent. **Flowers:** *pedicels* 3–8 mm long, *not conspicuously swollen near calyx*; calyx lobes 1–1.7 mm long; petals oblong to obovate, 3.5–4 × 2–3 mm, creamy-white; staminal tube 2–3 mm diameter, lobes acute to apiculate or bifid to retuse. **Fruits** depressed globose, 6–11 cm diameter. **Seeds** 5–10, 4–6.5 cm long.

Vernacular name. Sarawak—*nyireh-peti* (Iban), *nyireh batu* (Malay).

Distribution. Tropical Asia from India (Sundarbans) to tropical Australia. In Borneo, known in Sabah from Sandakan district (e.g., *SAN 81797* and *SAN 84119*) and in Sarawak from Kuching, Sarikei and Sibu districts (e.g., *S 7741*, *S 26721* and *S 30655*). Also occurring in Brunei and Kalimantan, but no specimens were seen at KEP.

Ecology. Mangrove swamps, most commonly in the upper reaches, often in only slightly brackish water. This species has been widely confused with the previous species, the first clear distinction being made by Beccari (*op. cit.*).

POLYGALACEAE

W.J.J.O. De Wilde & Brigitta E.E. Duyfjes

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A.W. Bennett in Hooker *f.*, Fl. Br. Ind. 1 (1872) 200; King, J. As. Soc. Beng. 59, 2 (1890) 129; Chodat, Monogr. Polygalacearum I, Mém. Soc. Phys. Hist. Nat. Genève, Suppl. (1891) 1, *ibid.* II (1893) 1, in Engler & Prantl, Nat. Pflanz. Fam. III, 4 (1896) 343; Merrill, EB (1921) 324; Ridley, FMP 1 (1922) 137; Masamune, EPB (1942) 378; Backer & Bakhuizen *f.*, FJ 1 (1964) 196; Ng, TFM 1 (1972) 351; Anderson, CLTS (1980) 286; Meijden, Leiden Bot. Ser. 7 (1982) 1, FM 1, 10 (1988) 455; Eriksen, Pl. Syst. Evol. 186 (1993) 33; Turner, Gard. Bull. Sing. 47 (1995) 404; Coode *et al.* (eds.), CLBD (1996) 253; Argent *et al.* (eds.), MNDT-CK 2 (1997) 503; Pendry, Fl. Thailand 7, 3 (2001) 498; Beaman & Anderson, PMK 5 (2004) 261.

Trees, shrubs, woody climbers, autotrophic green-leaved or saprophytic herbs. **Stipules** absent. **Leaves** simple, entire, spirally arranged or sometimes (sub)opposite or whorled, sometimes small, scale-like and without chlorophyll. **Inflorescences** usually raceme-like, branched or unbranched, or flowers solitary; bracts present; bracteoles basal, rarely absent. **Flowers** bisexual, mostly bilaterally symmetrical; sepals 5, free, overlapping, or the lower 2 (rarely all) fused, subequal or the two lateral ones enlarged and petaloid (petal-like); petals 3 or 5, free or at base variously fused, also fused with the sepals or with the staminal tube, or with the filaments, equal or unequal, the lower ones often forming a carina (keel); stamens (2–)8(–10), filaments usually more or less united, or free, anthers basifixed, 1- or 2-locular, opening by a single apical pore or (longitudinal) introrse slit(s); disc present or absent; ovary superior, 1–8-locular, with 1 ovule per locule, or in *Xanthophyllum*, 1-locular (2-carpellate) with 4 or more ovules, style simple, stigma simple or lobed, ovules anatropous, with two integuments and a thick nucellus. **Fruit** berry-like, or a capsule, samara (winged nutlet) or drupe. **Seed** 1 or more, usually with endosperm.

Distribution. Worldwide about 15 genera with over 1000 species, in tropical and temperate regions; especially well developed in South America and South Africa. In Sabah and Sarawak 5 genera with about 69 species, of which the SE Asian genus *Xanthophyllum* Roxb. is woody, all species being trees, treelets or shrubs, and well represented (52 species and 3 incompletely known taxa) in the Flora area.

Ecology. As the genera represent a wide range of life forms in temperate and tropical regions, also in Borneo, members of the family can be found almost everywhere. The large worldwide genus *Polygala* L. consists mainly of heliophilous herbs, of which the originally American species *P. paniculata* L. is a common pantropical weed; *Salomonina* Lour. (few species in Sabah and Sarawak) are weedy herbs; *Epirixanthes* Blume (few species in Sabah and Sarawak) are tiny saprophytic shade plants; members of *Securidaca* L. (two species in Sabah and Sarawak) are woody climbers; *Xanthophyllum* is in Asia the largest genus of forest shrubs and trees.

Cross-pollination by insects is regarded as common in the family, because the flowers frequently look adapted for this in shape and colour. However, self-pollination was proved

effective in several cases, and possibly the rule, also in *Xanthophyllum*, although in this genus the flowers particularly seem to be constructed for pollination by insects.

Almost all modes of dispersal are represented in the family, corresponding to the great diversity in fruit and seed types. In *Xanthophyllum* dispersal by birds and small mammals, even monkeys, is possible.

Notes. Polygalaceae is a well defined family. Features of wood anatomy and pollen are diverse, but characteristic for the family, giving little evidence for relationship with other families. The genus *Xanthophyllum* has been regarded as a family of its own, but Meijden *op. cit.* (1982) convincingly proved that it should remain in the family as one of three tribes based on differences in floral structure (*Polygaleae*, *Moutabeae* and *Xanthophylleae*) as already recognised since Chodat *op. cit.* (1896). Relationship through the general resemblance of *Xanthophyllum* flowers to those of the Fabaceae (Caesalpinioideae and Faboideae) is spurious, although recent molecular research points to ties with Fabaceae (<http://www.MOBOT/research/APweb/orders/fabalesweb.htm>; 1st Sept. 2006).

Uses. None of the genera has significant economic value. The roots of the weedy *Polygala paniculata* are locally sold as they release a pleasant perfume (coumarins). The largest woody representatives are found in *Xanthophyllum*, but have as yet no commercial value in the timber trade.

Key to genera

1. Herbs, exceptionally with woody stem. Ovary 2-locular.....2
 Trees, shrubs or lianas. Ovary 1-locular.....4
2. Sepals unequal, the lateral ones larger than other sepals and petaloid, about as long as the petals. Lower petals (keel) appendiculate at apex. Stamens 8. Fruits often with low wing all round.....
Polygala L.
 (Greek, *polus* = much, *gala* = milk; referring to the supposed property of the plant in stimulating milk secretion)
 Sp. Pl. 2 (1753) 701; Merrill, EB (1921) 324; Masamune, EPB (1942) 378; Adema, Blumea 4 (1966) 256; Anderson, CLTS (1980) 286; Meijden, FM 1, 10 (1988) 459; Coode *et al.* (eds.), CLBD (1996) 254; Beaman & Anderson, PMK 5 (2004) 262.
 Annual or perennial herbs, rarely shrubs or low climbers. Lateral sepals large, petaloid, about as long as petals; keel with appendages. Stamens 8, variously fused. Ovary 2-locular. Capsule dehiscent, usually with low wing around. Seed with a lobed aril or long hairs (coma).
 A large genus of more than 500 species, all over the world. In Sabah and Sarawak five species but only one, *P. venenosa* Poir., is a stout herb or a low shrub, which exceptionally may attain the stature of a small tree.
 Sepals all subequal, not petaloid, much shorter than the petals. Lower petal without apical appendages. Stamens 2-6. Fruits not winged.....3
3. Plant with green leaves. Fruits leathery, dehiscent, exceeding the sepals.....
Salomonina Lour., *nom. cons.*
 (King Salomo, 971-931 A.D.)

Fl. Cochin. 1 (1790) 14; Merrill, EB (1921) 324; Masamune, EPB (1942) 378; Meijden, FM 1, 10 (1988) 486; Coode *et al.* (eds.), CLBD (1996) 254; Beaman & Anderson, PMK 5 (2004) 263.

About three species distributed from India, Sri Lanka and Nepal to China, Japan, S Korea, Taiwan, Indo-China, Thailand, Malesia and N Australia. In Sabah and Sarawak two species, *S. cantonensis* Lour. and *S. ciliata* L., are small weedy herbs. Plant saprophytic, pale, with scale-like brownish leaves. Fruits fleshy, indehiscent, enclosed by the sepals.....

Epirixanthes Blume

(Greek, *epi* = on, *rhiza* = root, *anthos* = flower; referring to the plant which grows on the root of a host, but the plant is saprophytic)

Cat. Gew. Buitenzorg (1823) 25, 82; Endlicher, Gen. Pl. (1839) 728 (*'Epirhizanthus'*); Merrill, EB (1921) 325; Masamune, EPB (1942) 378; Meijden, FM 1, 10 (1988) 488; Coode *et al.* (eds.), CLBD (1996) 253; Beaman & Anderson, PMK 5 (2004) 261.

Erect, little-branched, saprophytic herbs with small, bract-like erect leaves.

Five species distributed from India to China, Malesia and Solomon Islands. All five species occur in Borneo.

4. Lianas. Petals 3. Ovary with 1 ovule. Fruits with a long coriaceous wing.

Securidaca L., *nom. cons.*

(Latin, *securis* = axe; referring to the shape of the fruit)

Syst. Nat. ed. 10 (1759) 1155; A.W. Bennett *in* Hooker *f.*, Fl. Br. India 1 (1872) 207; Chodat *in* Engler & Prantl, Nat. Pflanz. Fam. III, 4 (1896) 340; Meijden, FM 1, 10 (1988) 483; Coode *et al.* (eds.), CLBD (1996) 254; Beaman & Anderson, PMK 5 (2004) 263.

Woody climbers, without tendrils. Inflorescences (racemes or) panicle-like; sepals 5, unequal; petals 3, halfway adnate to staminal tube, lower one keel-like; stamens 8, monadelphous; ovary 1-locular, with 1 ovule. *Fruit a winged nutlet* (samara). Seed glabrous, not arillate.

About 80 species mainly in S and C tropical America; four species in SE Asia, with two species, *S. inappendiculata* Hassk. and *S. philippinensis* Chodat, in Sabah and Sarawak.

Trees (or shrubs). Petals 5. Ovary 1-locular, with 4 or more ovules. Fruit (sub)globose, not winged.....**Xanthophyllum**

XANTHOPHYLLUM Roxb., *nom. cons.*

(Greek, *xanthos* = yellow, *phullon* = leaf; referring to the leaves, often yellow when dry)

minyak berok (Malay), *nyalin* (Iban; preferred name in Sarawak)

Pl. Corom. 3 (1820, '1819') 81; A.W. Bennett *in* Hooker *f.*, Fl. Br. Ind. 1 (1872) 208; King, J. As. Soc. Beng. 59, 2 (1890) 134; Chodat, Bull. Herb. Boiss. 4 (1896) 254, *in* Engler & Prantl, Nat. Pflanz. Fam. III, 4 (1896) 343, *in* Merrill, PEB (1929) 133; Ridley, FMP 1 (1922) 137; Masamune, EPB (1942) 378; Ng, TFM 1 (1972) 352; Anderson, CLTS (1980) 286; Meijden, Leiden Bot. Ser. 7 (1982) 60, FM 1, 10 (1988) 493; Kessler & Sidiyasa, TBASA-EK (1994) 192; Turner, Gard. Bull. Sing. 47 (1995) 405; Coode *et al.* (eds.), CLBD (1996) 253; Argent *et al.* (eds.), MNDT-CK 2 (1997) 503; Pendry, Fl. Thailand 7, 3 (2001) 525; Beaman & Anderson, PMK 5 (2004) 263. **Synonyms:** *Jakkia* Blume, Cat. Gew. Buitenzorg (1823) 17, Bijdr. Fl. Ned. Ind. (1825) 60 (*'Jackia'*), *non Jackia* Wallich, *nec Jackia* Sprengel; *Skaphium* Miq., Fl. Ind. Bat., Suppl. (1861) 357.

Trees, large or small, *or shrubs*. **Twigs** terete, often smooth, green or yellow, sometimes with nodal glands. Growth always sympodial; in each flush the terminal bud aborts, and growth is continued through the axillary bud of the uppermost leaf. **Axillary buds** solitary or in clusters of 2–8, each with 2 bud scales. **Leaves** alternate (or spiral), sometimes partly shifted-decussate (subopposite), stalked, nearly always with glands beneath, drying yellowish (*X. flavescens*, mostly), green or (dark) brown; *petiole* often finely transversely wrinkled when fresh. **Inflorescences** axillary (and terminal), branched or unbranched. **Flowers** mostly bilaterally symmetrical, solitary or with 3 (rarely more) together; *sepals* 5, free, slightly unequal, sometimes persistent; *petals* 5, usually unequal, free, lower petal usually boat-shaped (keel), unguiculate (contracted at the base into a claw), inappendiculate (subequal without keel in *X. ecarinatum*, *X. stipitatum*); *stamens* (7–)8(–10), 4 epipetalous, 2 placed at the base of the keel and adnate with it or not, and two alternipetalous and opposite the lateral sepals, filaments free or partly united basally (up to halfway), sometimes triadelphous, anthers opening introrsely with longitudinal slits; *disc* annular; *ovary* usually short stipitate, composed of 2 median carpels, *1-locular*, style terminal, curved, about as long as stamens, stigma small, slightly 2-lobed or peltate, *ovules* 4 or (6–)18 (rarely more). **Fruits** indehiscent, not winged, (*sub*)*globose*, 1–15 cm diameter, usually with a firm pericarp. **Seeds** 1 or 4 or more, inappendiculate, glabrous; embryo large, cotyledons flat or thick, albumen copious to nearly absent.

Distribution. About 100 species, in tropical Asia, including S India, Sri Lanka, northwards to S China and Hainan, mainly in Malesia, east to N Australia. In Sabah and Sarawak, 55 species (including 3 incompletely known taxa and 1 shrub species) are recognised; 41 species are endemic in Borneo with 23 species occurring only in Sabah and Sarawak. Borneo is the main centre of *Xanthophyllum* species diversity in W Malesia, but the origin of the genus is believed to be in E Malesia (New Guinea, Australia). None of the Bornean species cross Wallace's Line to E Malesia.

Ecology. All species are confined to primary (or degraded primary) forest vegetation types; the majority in lowland rain forest, where often recorded as found along rivers, below 500 m altitude. Some species grow in hill and montane forest at altitudes between 500–1200(–2000) m, and others occur in (peat)swamp forest or *kerangas* forest.

Uses. The fruit of some species (e.g., *X. ecarinatum*, *X. obscurum*, *X. stipitatum*) with pulp around the seeds has been recorded as edible. The trees generally do not reach timber size, and thus are not of commercial value. *Xanthophyllum brevipes*, with drooping branches, is potentially an ornamental roadside tree. Locally, the wood is frequently used for making knife handles and sheaths.

Notes. *Xanthophyllum* seems the most primitive genus in the family, with subequal sepals and sometimes a rather weak asymmetrical corolla, but Meijden (*op. cit.* 1982) pointed out that this is mainly deceptive. He distinguished 7 subgenera of which 5 are represented in the Flora area. The criteria for this division are derived from a fairly large set of often complicated and not readily seen characters, mainly concerning the following: axillary buds; glands on leaves and inflorescences; mode of leaf venation; hairiness of sepals; shape, size and indumentum of petals; mode of fusion of stamens; details of the ovary, style and stigma; number of ovules (generally 4 versus 8 or more); size of fruit and number of seeds; and especially characters of the seeds, albumen present or absent, and the embryo. This subdivision, with accompanying descriptions, is not directly useful for recognizing the species, and most of the 'difficult' characters are left out in the two keys to the species and the descriptions. Unfortunately, the number of ovules has to be used in some cases.

Key to *Xanthophyllum* subgenera and sections

1. Fruit 1-seeded (exceptionally 2-seeded).....2
 Fruit 4- or more-seeded.....5
2. Stamens triadelphous. Embryo flat, covered by copious endosperm. Twigs with nodal glands.....
 Subgen. **Triadelphum** Meijden
 Species in Sabah and Sarawak included in this subgenus are: 9. *X. contractum* [flowers unknown], 12. *X. ellipticum*, 18. *X. hildebrandii* and 24. *X. montanum*.
 Stamens monadelphous or free. Embryo thick, without or with little endosperm. Twigs mostly without nodal glands.....3
3. Stamens monadelphous. Stigma peltate. Twigs with a pair of annular nodal glands.....
 Subgen. **Coriaceum** Meijden
 In Sabah and Sarawak represented by: 38. *X. ramiflorum*.
 Stamens free, *i.e.* filaments free or to 0.5–1.5(–2.5) mm connate. Stigma slightly 2-lobed. Twigs without nodal glands.....4
4. Intercostal venation scalariform. Testa sticking to the inner side of the fruit wall on drying. Albumen absent.....
 Subgen. **Xanthophyllum** sect. **Xanthophyllum**
 In Sabah and Sarawak represented by: 13. *X. ferrugineum*, 14. *X. flavescens*, 16. *X. havilandii*, 23. *X. macrophyllum*, 41. *X. resupinatum*, 43. *X. rufum*, 44. *X. schizocarpon* and 50. *X. velutinum*.
 Intercostal venation reticulate. Testa sticking to the rest of the seed on drying. Albumen present, though sometimes scarce.....
 Subgen. **Xanthophyllum** sect. **Eystathes** (Lour.) Meijden
 In Sabah and Sarawak represented by: 1. *X. adenotus*, 2. *X. beccarianum*, 3. *X. bicolor*, 4. *X. borneense*, 5. *X. brachystachyum*, 7. *X. ceraceifolium*, 8. *X. clovis*, *X. crassum*, 10. *X. discolor*, 15. *X. griffithii*, 17. *X. heterophyllum*, 19. *X. impressum*, 20. *X. korthalsianum*, 21. *X. lineare*, 22. *X. longum*, 25. *X. neglectum*, 26. *X. nigricans*, 27. *X. nitidum*, 29. *X. ovatifolium*, 30. *X. pachycarpon*, 31. *X. parvifolium*, 32. *X. pauciflorum*, 33. *X. pedicellatum*, 34. *X. penibukanense*, 35. *X. pseudoadenotus*, 36. *X. pulchrum*, 37. *X. purpureum*, 39. *X. rectum*, 40. *X. reflexum*, 42. *X. reticulatum*, 46. *X. subcoriaceum*, 47. *X. tardicrescens*, 48. *X. tenue*, 49. *X. trichocladum*, 51. *X. vitellinum*, 52. *Xanthophyllum* sp. A, 53. *Xanthophyllum* sp. B and 54. *Xanthophyllum* sp. C.
5. Embryo thick, covered with little endosperm.....
 Subgen. **Brunophyllum** Meijden
 In Sabah and Sarawak represented by: 6. *X. brevipes*, 11. *X. ecarinatum* and 28. *X. obscurum*.
 Embryo flat, covered with copious endosperm.....
 Subgen. **Exsertum** Meijden
 In Sabah and Sarawak represented by: 45. *X. stipitatum*.

Key to *Xanthophyllum* species
(primarily using flower and fruit characters)

Notes: It could not be avoided to use occasionally two character states to be seen only with high magnification. Whether the leaves beneath are papillose or not papillose should be examined with a magnification of at least 25x. The number of ovules in the ovary must be ascertained in living or boiled material after longitudinally sectioning the ovary; the section to be started at the apex.

1. Leaves patently long-hairy below, at least on midrib; hairs 0.5 mm long or more. [Ovules 8–16].....2
 Leaves glabrous below, or minutely appressed or patently short-hairy, hairs *c.* 0.2 mm long or less. [Ovules 4, 8 or more].....9
2. Intercostal venation scalariform, at least (partly) between lower lateral veins. Inflorescences (normally) branched.....3
 Intercostal venation all reticulate. Inflorescences unbranched.....4
3. Leaves papillose below. Ovary and fruit hairy all round or in 4 rows in upper half.....**43. *X. rufum***
 Leaves not or indistinctly papillose below. Ovary and fruit glabrous or hairy in 2 rows in upper half.....**50. *X. velutinum***
4. Sepals and inflorescence axes with hairs *c.* 1 mm long.....**49. *X. trichocladum***
 Sepals and inflorescence axes with hairs 0.1–0.5 mm long.....5
5. Leaves bullate (blistered) between the intercostal veins.....**42. *X. reticulatum***
 Leaves not bullate (flat) between the intercostal veins.....6
6. Pedicels 2–5(–7) mm long. Longest petals 11–12 mm long. Anthers 0.5–1.5 mm long.....7
 Pedicels (5–)7–15 mm long. Longest petals 12–16 mm long. Anthers 1.5–2 mm long.....8
7. Twigs up to 1 mm diameter. Inflorescences *c.* 1 cm long or less. Anthers *c.* 0.5 mm long.....**5. *X. brachystachyum***
 Twigs 2–3 mm diameter. Inflorescences longer than 2 cm. Anthers 1–1.5 mm long.....**37. *X. purpureum***
8. Petioles 3–6 mm long. Pedicels 7–10 mm long. Petals 15–16 mm long. Anthers *c.* 2 mm long.....**2. *X. beccarianum***
 Petioles 1.5–3 mm long. Pedicels 9–15 mm long. Petals *c.* 12 mm long. Anthers *c.* 1.5 mm long.....**33. *X. pedicellatum***
9. Leaves papillose or indistinctly papillose and often more or less dull glaucous or whitish below.....10
 Leaves not papillose and usually not glaucous below.....24
10. Intercostal venation scalariform. Ovary glabrous or hairy on median ribs.....**44. *X. schizocarpon***

- Intercostal venation reticulate. Ovary glabrous or hairy, not especially on median ribs.....11
11. Ovary (fruit) glabrous.....12
 Ovary (fruit) hairy (glabrescent), at least towards apex and base.....14
12. Ovules 4. Anthers up to 0.4 mm long.....**4. X. borneense** (in part)
 Ovules 8–18. Anthers at least 0.7 mm long.....13
13. Petioles (5–)8–12 mm long. Longest petals *c.* 8 mm long. Fruit 1(or 2)-seeded, *c.* 1 cm diameter. Flowering on the older wood. Exclusively in peatswamp forest.....**38. X. ramiflorum**
 Petioles 1.5–3 mm long. Longest petals 15–16 mm long. Fruit 10- or more-seeded, *c.* 4 cm diameter. Flowering among the leaves.....**6. X. brevipes**
14. Ovules 8–16 (occasionally 4 in *X. discolor*).....15
 Ovules 4.....19
15. Petioles 20–30 mm long.....**3. X. bicolor**
 Petioles (3–)6–15 mm long.....16
16. Petioles transversely wrinkled, at apex passing into the narrowly attenuate leaf base. Lower pair of lateral veins usually reaching beyond the middle of the blade.....**34. X. penibukanense**
 Petioles transversely or longitudinally wrinkled, not passing into a narrowly attenuate leaf base (base cordate, rounded or attenuate). Lower pair of lateral veins not usually reaching the middle of the blade.....17
17. Leaves *c.* 10 cm long or less. Twigs slender, at apex 1–2 mm diameter. Ovules 4 or 8.....**10. X. discolor**
 Leaves generally more than 10 cm long. Twigs stouter, at apex 2–4 mm diameter. Ovules 8–15.....18
18. Petioles 4–8 mm long. Leaf base (sub)cordate.....**36. X. pulchrum**
 Petioles 10–15 mm long. Leaf base attenuate.....**35. X. pseudoadenotus**
19. Axillary buds mostly more than (1.5–)4 mm long.....20
 Axillary buds at most 1.5 mm long.....22
20. Axillary buds situated (1.5–)3–15 mm above the leaf axil and placed on a 0.5–1.5 mm long stalk.....**20. X. korthalsianum**
 Axillary buds situated in the leaf axil, sessile.....21
21. Scales of axillary bud at apex with 2 distinct thickenings, rendering the bud clove-shaped.....**8. X. clovis**
 Scales of axillary bud not thickened at apex.....**15. X. griffithii** (in part)
22. Leaves 2–5(–6) cm long. Flowers solitary or in up to 3-flowered inflorescences. Pedicels 7–11 mm long.....**31. X. parvifolium**
 Leaves, at least on the average, more than 5 cm long. Inflorescences either with more than 6 flowers, or when less, then flowers on 2–4 mm long pedicels.....23

23. Inflorescences shorter than 5 cm, unbranched.....**32. X. pauciflorum**
 Inflorescences longer, to 20 cm long, branched (sometimes seemingly unbranched if lower bracts resemble leaves).....**19. X. impressum**
24. Ovary (fruit) hairy all round, not glabrous laterally.....25
 Ovary (fruit) glabrous, at least laterally, or hairy only on ribs.....43
25. Axillary buds (2–)3 mm long or longer.....26
 Axillary buds up to 2 mm long.....33
26. Axillary buds 10–20(–30) × 6–12(–14) mm, flat and leaf-like, at base attenuate and not thickened, at apex rounded to obtuse.....**17. X. heterophyllum**
 Axillary buds 2–11 mm long, not leaf-like.....27
27. Axillary buds erect, flattened against the twig, very densely short-hairy.....
**40. X. reflexum**
 Axillary buds half-patent to patent, glabrous or sparsely short-hairy.....28
28. Inflorescences unbranched or hardly branched.....29
 Inflorescences branched.....30
29. Petioles slender, 4–7 mm long. Leaves membranous or chartaceous, with 3–5 pairs of lateral veins.....**25. X. neglectum** (in part)
 Petioles thick, 8–10 mm long. Leaves thickly coriaceous, with 4–7 pairs of lateral veins.....

X. crassum W.J.de Wilde & Duyfjes

(Latin, *crassus* = thick; referring to the thick leaves)

(subgen. **Xanthophyllum**, sect. **Eystathes**)

Gard. Bull. Sing. 57 (2005) 50. Type: *Sugau SAN 134307*, Borneo, Sabah, Kinabatangan district, Bt. Tawai (holotype SAN).

Shrub or treelet *c.* 2 m tall, *c.* 3 cm diameter. Bark blackish brown. Twigs *without nodal glands*, black, glabrous, 4–5 mm thick. Axillary buds *solitary*, long-conical, (2–)4–5 mm long, *patent*, *glabrous*. Leaves *glabrous*, *thickly coriaceous*, *flat*, dark brown above, *not papillose below*; blade (shortly) ovate-elliptical, 6–10(–12) × 4–6(–7) cm, base broadly rounded, apex rounded with short, broad, blunt tip; midrib slightly raised above; *lateral veins 4–7 pairs*, *not forming an intramarginal vein*; *intercostal venation reticulate*, flat and indistinct below; *glands few*, *scattered*, *less than 0.5 mm diameter*; *petioles 8–10 mm long*, stout, black on drying, glabrous, without glands, *smooth*. Inflorescences *stout*, *erect*, (almost) *unbranched*, finely yellow-brown appressed hairy; axes 5–7 cm long, 3–4 mm thick, 10–15-flowered. Flowers solitary or 2–3 together; pedicels short, stout, 4–5 mm long; sepals 5–6 mm long, densely appressed yellow-brown hairy; petals 14–15 mm long, purple-black on drying, partly grey-yellow appressed hairy; stamens and pistil not seen; *ovary* subglobose, *c.* 2.5 mm diameter, *densely yellow-brown subpatently hairy all around*, hairs *c.* 0.5 mm long, *ovules 4*. Fruits unknown.

Endemic in Borneo and confined to Bt. Tawai in Sabah, where it is known only by the type specimen.

Stunted montane forest over ultrabasic rock, at *c.* 1250 m altitude.

30. Petioles (20–)25–30 mm long. Leaves 22–42 cm long; intercostal venation indistinct below.....**7. X. ceraceifolium**
 Petioles 4–20 mm long. Leaves shorter than 20 cm, when larger, then intercostal venation distinct and prominent below.....31
31. Leaves *c.* 4 times as long as wide. Petioles 8–20 mm long. Lateral veins 10–20 pairs. Anthers 0.6–1.2 mm long.....**1. X. adenotus**
 Leaves to 3 times as long as wide. Petioles 4–16 mm long. Lateral veins (4–)6–9 pairs. Anthers 0.4–0.7 mm long.....32
32. Twigs slender, 1(–2) mm diameter. Leaves (usually) pale below.....**15. X. griffithii** (in part)
 Twigs stouter, 2–3 mm diameter. Leaves dull brownish, not pale below.....**51. X. vitellinum** (in part)
33. Midrib sunken above. Ovules 8–12. Fruits large, 4–6 cm diameter.....**45. X. stipitatum** (in part)
 Midrib flat or prominent above. Ovules 4. Fruits much smaller (less than 2 cm diameter).....34
34. Inflorescences (infructescences) branched.....35
 Inflorescences (infructescences) unbranched or sometimes with a side-branch at the base.....38
35. Leaves 4–6 times as long as wide; lateral veins 9–14 pairs.....**21. X. lineare**
 Leaves to *c.* 3 times as long as wide; lateral veins 4–10 pairs.....36
36. Petioles 30–40 mm long.....**22. X. longum**
 Petioles 8–14(–16) mm long.....37
37. Intercostal venation coarsely reticulate; areoles subequal or unequal in size, 1–5 mm diameter.....**51. X. vitellinum** (in part; including **58. Xanthophyllum sp. B**)
 Intercostal venation sharply very finely reticulate; areoles of equal size, *c.* 0.5 mm diameter.....**27. X. nitidum**
38. Ovary and fruit appressed hairy. Petioles 3.5–5 mm long.....**47. X. tardicrescens**
 Ovary and fruit patently or half-patently hairy. Petioles more than 5 mm long.....39
39. Inflorescences stout, straight, erect, many-flowered.....**39. X. rectum**
 Inflorescences slender, small, subpatent, mostly less than 10-flowered.....40
40. Leaves coriaceous, apex (sub)obtuse.....**52. Xanthophyllum sp. A**
 Leaves membranous or subcoriaceous, apex acute-acuminate.....41
41. Axis of inflorescence less than 1 mm diameter. Fruits *c.* 1 cm diameter.....**25. X. neglectum** (in part)
 Axis of inflorescence 1–2 mm diameter. Fruits 1.5–2 cm diameter.....42
42. Fruits black, not wrinkled on drying.....**54. Xanthophyllum sp. C**
 Fruits light brown, wrinkled on drying.....**4. X. borneense** (in part)

43. Intercostal venation at least on parts of the leaf scalariform.....44
Intercostal venation reticulate.....49
44. Flowering on the older wood.....**9. X. contractum**
Flowering at apex of twigs.....45
45. Ovary and fruit hairy on 4 ribs in apical half, hairs brown.....**23. X. macrophyllum**
Ovary and fruit glabrous or hairy on 2 (or 4) ribs, hairs greyish.....46
46. Midrib flat below, prominent above; leaf base attenuating into a narrow petiole-like part.....**41. X. resupinatum**
Midrib prominent below, prominent to sunken above; leaf base not so.....47
47. Inflorescences branched or unbranched, axes or branches more or less thickened, with spaced and conspicuously raised scars of pedicels, or axes (branches) very densely set with flowers or scars of pedicels.....**16. X. havilandii**
Inflorescence axes branched, branches not thickened, except in upper part not densely set with flowers or scars of pedicels, scars not or but little raised.....48
48. Pedicels 1–1.5(–6) mm long. Sepals often persistent in fruit, medium brown with light coloured margin when dry; outer sepals sparsely minutely hairy.....
.....**13. X. ferrugineum** (in part)
Pedicels (2–)3–10 mm long. Sepals not persistent in fruit, without a lighter coloured margin when dry; outer sepals more densely hairy.....**14. X. flavescens** (in part)
49. Ovules 4.....50
Ovules 8 or more.....54
50. Petioles finely transversely wrinkled, 3–4(–6) mm long. Lateral veins 3–4 pairs. Inflorescences and pedicels (sub)glabrous, with *c.* 5 flowers.....**29. X. ovatifolium**
Petioles transversely wrinkled or not, (5–)6–11 mm long. Lateral veins 4–6 pairs. Inflorescences and pedicels hairy, mostly with 6 or more flowers.....51
51. Leaves (dark) brown on drying. Axillary buds densely short-hairy.....**26. X. nigricans**
Leaves green or light brown on drying. Axillary buds glabrous or sparsely short-hairy.....52
52. Fruits 2–3 cm diameter, with *c.* 7 mm thick spongy or solid pericarp.....
.....**30. X. pachycarpon**
Fruits 1–1.5(–1.8) cm diameter, with thin pericarp.....53
53. Style early caducous. Fruits dull, more or less wrinkled.....**48. X. tenue**
Style initially persistent on fruit. Fruits smooth, more or less shiny.....
.....**46. X. subcoriaceum**
54. Leaves greenish yellow on drying.....55
Leaves green(–brown) or dark brown on drying.....56
55. Pedicels 1–1.5(–6) mm long. Sepals often persistent in fruit, on drying medium brown with light coloured margin; outer sepals minutely hairy.....**13. X. ferrugineum** (in part)

- Pedicels (2–)3–10 mm long. Sepals not persistent in fruit, without a lighter coloured margin; outer sepals more or less hairy.....**14. X. flavescens** (in part)
56. Leaf glands rather numerous and distinct, 0.5–1 mm diameter, nearly all situated in the axils of lateral veins and midrib.....**18. X. hildebrandii**
 Leaf glands scattered or situated at the margins, not in the axils of lateral veins and midrib.....57
57. Fruits smaller, ovoid or globose, 1–2.2 cm across.....58
 Fruits larger, globose or subellipsoid, 4–14 cm across.....59
58. Leaf glands sometimes located near the margins of the blade but never on the margin itself. Anthers glabrous. Flowers bright brown when dry. Fruits yellowish to greenish brown when dry.....**24. X. montanum**
 Leaf glands located in upper half of the blade, with at least 6 glands on the margins. Anthers short-hairy along slits and at base. Flowers (sepals) often black when dry. Fruits black when dry.....**12. X. ellipticum**
59. Petals unequal, the lower middle one (keel) boat-shaped, distinct from the upper ones.....**28. X. obscurum**
 Petals nearly subequal in size and form.....60
60. Pedicels 1.5–5(–6) mm long. Stamens shorter than petals. Fruits subellipsoid; pericarp coarsely wrinkled when dry.....**11. X. ecarinatum**
 Pedicels at least 8 mm long. Stamens longer than petals. Fruits globose; pericarp smooth, not wrinkled when dry.....**45. X. stipitatum** (in part)

Key to *Xanthophyllum* species

(based on vegetative characters; excluding 52. *Xanthophyllum* sp. A, 53. *Xanthophyllum* sp. B and 54. *Xanthophyllum* sp. C)

Notes. To ascertain whether the leaf lower surface is papillose or not papillose, examination under 25x (at least) is needed.

1. Leaf intercostal venation scalariform or subscalariform.....2
 Leaf intercostal venation reticulate.....13
2. Leaves densely patently long-hairy below (at least on the midrib), the hairs 0.3–2 mm long.....3
 Leaves glabrous or appressedly or subpatently short-hairy below, the hairs to 0.2(–0.3) mm long.....4
3. Indumentum reddish brown. Leaves elliptical-oblong, papillose below; lateral veins 5–9 pairs; glands minute *c.* 0.1 mm diameter; upper part of petioles often with large glands.....**43. X. rufum**
 Indumentum grey or brown. Leaves narrowly elliptical to elliptical, smooth or indistinctly papillose below; lateral veins 8–11(–12) pairs; glands 0.2–0.6 mm diameter; petioles without glands.....**50. X. velutinum**
4. Leaves papillose below.....**44. X. schizocarpon**

Leaves not papillose below	5
5. Leaf intramarginal vein absent	9. X. contractum
Leaf intramarginal vein distinct or indistinct	6
6. Leaves bullate (blistered) between lateral and/or intercostals veins	7
Leaves not bullate (flat) between lateral and/or intercostals veins	9
7. Leaf intramarginal vein indistinct; glands located near the midrib	48. X. tenue (in part)
Leaf intramarginal vein distinct; glands scattered on the leaf blade	8
8. Leaves elliptical-oblong, base rounded or short-cuneate, apex acuminate-cuspidate; glands few to numerous; petioles 7–12 mm long, smooth, appressed short-hairy, without glands	16. X. havilandii
Leaves narrowly elliptical, base attenuate, apex acute-acuminate; glands few; petioles 10–18 mm long, longitudinally wrinkled, glabrous, often with 2–4 glands	23. X. macrophyllum
9. Axillary buds in clusters of 2–3	10
Axillary buds solitary, absent or inconspicuous	11
10. Leaves elliptical, oblong or rarely lanceolate, intramarginal vein distinct, base attenuate-rounded, apex acute(-acuminate); glands absent or if present few and scattered	14. X. flavescens (in part)
Leaves narrowly elliptical, intramarginal vein indistinct, base cuneate, apex long-acuminate; glands absent or it present few to numerous and located mostly near the midrib	48. X. tenue (in part)
11. Petioles smooth, with two glands. Leaf intramarginal vein distinct; laminar glands absent or few and scattered	14. X. flavescens (in part)
Petioles (finely) transversely wrinkled or smooth, without glands. Leaf intramarginal vein indistinct; laminar glands few, mainly located near leaf margin or confined to the upper half of leaf blade	12
12. Petioles 9–14 mm long; leaf base cuneate	13. X. ferrugineum (in part)
Petioles 4.5–7 mm long; leaf base attenuating into a narrow petiole-like part	41. X. resupinatum
13. Leaves bullate (at least sometimes) above	14
Leaves flat above	18
14. Axillary buds in clusters of 2–3(–4). Leaf apex acuminate-cuspidate	15
Axillary buds solitary. Leaf apex acutish	16
15. Leaves elliptical, margins sometime curved; intramarginal vein distinct; glands located at some distance from the midrib, basal glands absent	46. X. subcoriaceum
Leaves narrowly elliptical, margin always flat; intramarginal vein indistinct; glands located near the midrib, basal glands often present	48. X. tenue (in part)

16. Leaves oblong-lanceolate, 20–50 × 5–10(–15) cm, base cordate with the margins curved upwards and connate above the apex of petiole or flat and rounded or (broadly) cuneate; intramarginal vein distinct; glands located near the midrib; petioles 10–20 mm long, usually with 2 small prominent glands..... **1. X. adenotus**
 Leaves narrowly ovate-elliptical, 7–19(–30) × 2–6(–11) cm, base cuneate, obtuse or rounded-cordate, always flat; intramarginal vein distinct or indistinct; glands scattered; petioles 4–8 mm long, without glands..... 17
17. Leaves papillose below; intramarginal vein indistinct; petioles 4–8 mm long, appressed short-hairy, longitudinally or transversely wrinkled..... **36. X. pulchrum**
 Leaves not papillose or only indistinctly papillose below; intramarginal vein distinct; petioles to 5 mm long, patently long-hairy, smooth..... **42. X. reticulatum**
18. Petioles smooth (glabrous or hairy)..... 19
 Petioles longitudinally or transversely wrinkled..... 29
19. Leaves not papillose below; twigs, petioles, lower leaf surface glabrous or patently short-hairy..... 20
 Leaves papillose below; twigs, petioles, lower leaf surface densely patently long-hairy..... 25
20. Twigs with distinct nodal glands. Axillary buds solitary. Petioles to 6 mm long..... **18. X. hildebrandii**
 Twigs without nodal glands. Axillary buds in clusters of 2–3 or solitary. Petioles (5–)6–30(–40) mm long..... 21
21. Petioles (20–)30–40 mm long..... **22. X. longum**
 Petioles 5–15 mm long..... 22
22. Leaves ovate-elliptical, thick coriaceous, apex rounded with short, broad blunt tip; intramarginal vein absent..... **X. crassum** (see above)
 Leaves elliptical, oblong, lanceolate, or narrowly elliptical, not thick coriaceous, apex acute-acuminate or long-acuminate; intramarginal vein distinct or indistinct..... 23
23. Leaves drying yellowish, elliptical, oblong, rarely lanceolate, base attenuate-rounded..... **14. X. flavescens** (in part)
 Leaves drying brownish, (narrowly) elliptical, base cuneate..... 24
24. Petioles 6–11 mm long, glands absent or inconspicuous (small). Lateral veins 4–6 pairs..... **48. X. tenue** (in part)
 Petioles 8–14(–16) mm long, often with a pair of glands at the apical half. Lateral veins (6–)7–9(–11) pairs..... **51. X. vitellinum** (in part)
25. Leaves narrow, oblong-linear, apex long-acute; petioles to 2 mm long..... **5. X. brachystachyum**
 Leaves narrowly elliptic or elliptical, apex acutish; petioles (1.5–)3–7 mm long..... 26
26. Leaves smaller, 5–11 × 1.5–4 cm; petioles to 3 mm long..... **33. X. pedicellatum**
 Leaves larger, 8–31 × 2–9 cm; petioles 3–7 mm long..... 27

27. Axillary buds ovate-oblong, not thickened at base. Leaf base cordate, sometimes covering the upper side of petiole; intramarginal vein distinct; lateral veins 9–12 pairs.....**49. X. trichocladum**
 Axillary buds triangular, basally thickened. Leaf base otherwise, if cordate never covering the upper side of petiole; intramarginal vein absent, indistinct or distinct; lateral veins 5–8 pairs.....28
28. Leaves narrowly elliptical, base cordate; midrib slightly raised above; intramarginal vein indistinct. Flowers (petals) orange red; pedicels 7–15 mm long.....**2. X. beccarianum**
 Leaves elliptical or narrowly elliptical, base cordate, rounded-attenuate or cuneate; midrib slightly sunken or flat above; intramarginal vein, if present, distinct at least in the apical half of leaf blade. Flowers (petals) purple; pedicels 2–7 mm long.....**purpureum**
29. Leaves papillose below.....30
 Leaves not papillose below.....42
30. Leaf base long-attenuate, merging and forming part of petiole.....31
 Leaf base not so.....32
31. Petioles 20–30 mm long. Leaves oblong, 14–35 × 4.5–10 cm, apex rounded or bluntly acute; lateral veins 8–12 pairs; glands inconspicuous.....**3. X. bicolor**
 Petioles 8–15 mm long. Leaves ovate-elliptical, 7–18 × 2.5–7 cm, apex acute-acuminate; lateral veins 4–6 pairs; glands numerous, scattered on the leaf blade.....**34. X. penibukanense**
32. Leaves smaller, 1.5–9 × 0.5–3.5 cm; petioles 1.5–4.5 mm long.....33
 Leaves larger, (4–)7–20(–30) × 3–10 cm; petioles 5–30 mm long.....35
33. Twigs pendent; axillary buds absent or minute (less than 0.5 mm long). Leaves narrowly elliptical; lateral veins *c.* 10 pairs.....**6. X. brevipes**
 Twigs not pendent; axillary buds 0.5–1.5 mm long. Leaves elliptical-oblong, oblong or lanceolate; lateral veins 1–6 pairs.....34
34. Leaves elliptical-oblong, 1.5–5(–6) × 0.5–2 cm, base rounded or cuneate, apex long-acuminate with rounded tip; lateral veins 1–3 pairs, intramarginal vein indistinct; petioles 2–2.5 mm long.....**31. X. parvifolium**
 Leaves oblong or lanceolate, 5–8(–9) × 1.2–2.5(–3.5) cm, base acute, apex acuminate-cuspidate; lateral vein 4–6 pairs, intramarginal vein absent; petioles 3.5–4.5 mm long.....**32. X. pauciflorum**
35. Twigs with a pair of annular nodal glands.....**38. X. ramiflorum**
 Twigs without nodal glands.....36
36. Axillary buds clove-shaped. Petioles 9–20(–30) mm long.....**8. X. clovis**
 Axillary buds not clove-shaped. Petioles 4–15 mm long.....37
37. Twigs reticulately wrinkled. Axillary buds in clusters of 2 or 3.....**4. X. borneense** (in part)
 Twigs smooth. Axillary buds solitary.....38

38. Leaves $18-35 \times 5.5-10$ cm, base attenuate; lateral veins 12–14 pairs.....**35. X. pseudoadenotus**
 Leaves $4-20 \times 1-5(-9)$ cm, base cuneate or rounded; lateral veins 4–9 pairs.....39
39. Axillary buds arising at (1.5–)3–15 mm above the leaf axils, 1–2 mm stalked; scales leaf-like, $6-18 \times 1.5-8$ mm.....**20. X. korthalsianum**
 Axillary buds appearing at the leaf axils, sessile; scales not leaf-like.....40
40. Leaves narrowly ovate; petioles without glands.....**10. X. discolor**
 Leaves ovate-oblong, elliptical-oblong or narrowly elliptical; petioles sometimes with 1 or 2 glands at the apical part.....41
41. Leaves ovate-oblong or elliptical-oblong, $4-10 \times 1-5$ cm; lateral veins 4–6 pairs. Axillary buds not hidden between petiole base and low ridge of twig.....**15. X. griffithii** (in part)
 Leaves narrowly elliptical, $10-20 \times 3.5-9$ cm; lateral veins 8–9 pairs. Axillary buds mostly hidden between petiole base and low ridge of twig.....**19. X. impressum**
42. Leaves larger, $22-50 \times 7-18$ cm; petioles at least 18 mm long.....**7. X. ceraceifolium**
 Leaves smaller, $(2.5-)5-20(-38) \times (1-)2-7(-11)$ cm; petioles much shorter than 18 mm long.....43
43. Axillary buds longer than 5 mm.....44
 Axillary buds to 4 mm long.....47
44. Axillary buds (8–)10–20(–35) mm long, flat; scales leaf-like, wrinkled, sometime with 1–4 glands.....**17. X. heterophyllum**
 Axillary buds 5–7(–11) mm long, not flat; scales not leaf-like, smooth, without glands.....45
45. Twigs stout 2–3 mm diameter. Axillary buds not patent (erect). Petioles 8–14(–16) mm long. Leaf lateral veins (6–)7–9(–11) pairs.....**51. X. vitellinum** (in part)
 Twigs slender. Axillary buds half-patent. Petioles 4–7(–12) mm long. Leaf lateral veins 3–6 pairs.....46
46. Petioles without glands, 4–7 mm long. Leaves narrowly elliptical, margin undulate; intramarginal vein distinct.....**25. X. neglectum** (in part)
 Petioles sometimes with 1 or 2 glands at the apical part, 5–12 mm long. Leaves ovate-oblong or elliptical-oblong, margin plane; intramarginal vein indistinct.....**15. X. griffithii** (in part)
47. Axillary buds in clusters of 2, 3 or 4.....48
 Axillary buds solitary (or 2).....52
48. Twigs reticulately or finely longitudinally wrinkled.....49
 Twigs smooth.....50
49. Twigs reticulately wrinkled. Axillary buds glabrescent. Leaves elliptical-oblong larger, $8-16 \times 3.5-7$ cm, base attenuate; glands scattered.....**4. X. borneense** (in part)

- Twigs finely longitudinally wrinkled. Axillary buds densely patently short-hairy. Leaves elliptical to narrowly elliptical, smaller, $3.5\text{--}12 \times 1.2\text{--}5.5$ cm, base cuneate; glands inconspicuous, mostly located near midrib.....**26. X. nigricans**
50. Lateral veins 5–7 pairs.....**45. X. stipitatum**
Lateral veins 3–5 pairs.....51
51. Leaves ovate-elliptical, smaller, $3.5\text{--}9.5 \times 1.4\text{--}6$ cm; intramarginal vein absent. Axillary buds 1–1.8 mm long.....**29. X. ovatifolium**
Leaves narrowly elliptical, larger, $7\text{--}16 \times 2\text{--}5(-7)$ cm; intramarginal vein distinct. Axillary buds less than 1 mm long.....**47. X. tardicrescens**
52. Petioles (1.5–)3–7 mm long.....53
Petioles (5–)7–12(–18) mm long.....56
53. Lateral veins 3–5 pairs. Axillary buds half-patent, 1.5–4 mm long.....**25. X. neglectum** (in part)
Lateral veins 5–9 pairs. Axillary buds not half-patent, minute and inconspicuous, to 1 mm long.....54
54. Leaves ovate-oblong, base rounded or attenuate; intramarginal vein indistinct; nodal glands absent.....**11. X. ecarinatum**
Leaves ovate-elliptical or oblong, base cuneate; intramarginal vein distinct; nodal glands present.....55
55. Leaves ovate-elliptical, larger, $5\text{--}20 \times 2\text{--}7$ cm, margin sometimes crenulated with at least 6 glands.....**12. X. ellipticum**
Leaves oblong, smaller, $(4\text{--})6\text{--}9 \times 1\text{--}2.5(-3.5)$ cm, margin plane without glands.....**24. X. montanum**
56. Twigs with distinct nodal glands.....**28. X. obscurum**
Twigs without nodal glands.....57
57. Twigs lengthwise finely grooved, patently short-hairy. Axillary buds appressed against twig. Petioles patently short-hairy. Laminar glands few, located near leaf base.....**40. X. reflexum**
Twigs smooth, usually glabrous. Axillary buds not so. Petioles glabrous. Laminar glands absent, inconspicuous or if present not or rarely located near leaf base.....58
58. Lateral veins (6–)7–14 pairs.....59
Lateral veins 4–7 pairs.....60
59. Leaves linear or linear-lanceolate, parallel-sided; petioles coarsely wrinkled, without glands.....**21. X. lineare**
Leaves (narrowly) elliptical, not parallel-sided; petioles finely wrinkled, often with a pair of glands at the apical part.....**51. X. vitellinum** (in part)
60. Laminar glands, few to numerous, scattered or located near midrib or leaf margin.....61
Laminar glands absent or inconspicuous.....62

61. Axillary buds inconspicuous. Leaves larger, 8–20 × 3–7 cm; glands few, located near leaf margin; petioles without glands.....**13. X. ferrugineum** (in part)
 Axillary buds distinct, half-patent. Leaves smaller, 4–10 × 1–5 cm; glands few to numerous, scattered or located near midrib; petioles sometimes with 1 or 2 glands at the apical part.....**14. X. griffithii** (in part)
62. Twigs stout, c. 5 mm diameter, black. Axillary buds minute, less than 0.5 mm long. Leaf intramarginal vein absent.....**39. X. rectum**
 Twigs slender, not black. Axillary buds 1–1.5 mm long. Leaf intramarginal vein distinct or indistinct.....63
63. Axillary buds short-hairy. Leaves oblong-lanceolate; intramarginal vein indistinct.....**27. X. nitidum**
 Axillary buds glabrous. Leaves oblong; intramarginal vein distinct.....**30. X. pachycarpon**

1. *Xanthophyllum adenotus* Miq.

Fig. 1.

(Greek, *adenos* = gland; referring to glands on the leaves)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Fl. Ind. Bat., Suppl. (1861) 393; Meijden *op. cit.* (1982) 100, *op. cit.* (1988) 515; Coode *et al.* (eds.) *op. cit.* 255; Beaman & Anderson *op. cit.* 263. **Lectotype** (Meijden, 1982): *Teijsmann HB 509*, Sumatra, Padang, Pulau Pisang (BO; isoelectotype U [Acc. No. 40600]). **Synonyms**: *X. cordatum* Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 274; *X. cordatum* Miq. f. *aequale* Chodat *op. cit.* (1929) 133; *X. arsatii* C.E.F.Fisch., Bull. Misc. Inform. Kew (1932) 176.

Shrub or tree, to 15 m tall and 25 cm diameter. **Bark** smooth. **Sapwood** white, yellow or pale orange. **Twigs** green, *smooth, without nodal glands*, glabrous or patently short-hairy. **Axillary buds** *solitary, half-patent to patent*, ovate-oblong to lanceolate, (2–)3–6(–10) mm long, *glabrous or sparsely short-hairy*, hairs to 0.2 mm long. **Leaves** chartaceous, *somewhat bullate between lateral veins*, greyish green or brown above, brownish, *glabrous or patently short-hairy and not papillose below*; blades oblong-lanceolate, 20–50 × 5–10(–15) cm, base cordate with the margins curved upwards and connate above the apex of the petiole, or flat and rounded, or (broadly) cuneate, apex acutish; midrib slightly raised above; lateral veins 10–20 pairs, forming an intramarginal vein; intercostal venation reticulate, distinct and prominent below; glands 2–6(–20), usually located near the midrib (if few, only present in basal part), 0.3–0.4 mm diameter; petioles 10–20 mm long, glabrous or short-hairy, usually with 2 small, prominent glands, wrinkled. **Inflorescences** sometimes on the older nodes, stout, branched; axes angular, sparsely or densely short-hairy; flowers solitary (or in a cluster of 2); lower bracts opposite. **Flowers**: pedicels 1–3.5 mm long, densely short-hairy; sepals often with minute glands, outer sepals 2–4 mm long, inner sepals 3–5.5 mm long; petals pinkish to pale violet, the upper petals with a yellow spot, drying dark red, the longest one 9–14 mm long, keel unguiculate (clawed), hairy outside, other petals hairy above base and near apex; filaments free or 1(–2) mm connate, widened above base and with a hairy knob-like thickening at inner side, for the rest glabrous, anthers 0.6–1.2 mm long, ciliate along slits; ovary (half-)patently hairy all around, style glabrous near apex, stigma slightly 2-lobed, ovules 4. **Fruits** globose, 1.5–1.8 cm diameter, dull, pale or reddish brown, hairy; pericarp thin, brittle; fruiting pedicels 2–5 mm long. **Seed** 1.

Vernacular names. Sabah—*burangkuk* (Dusun Kinabatangan), *kurapit* (Murut), *sintotobou* (Tenggara). Sarawak—*manok indu* (Engkari Iban).

Distribution. Sumatra and Borneo.

Notes. The stout petioles of large-leaved specimens are somewhat swollen, transversely wrinkled and (green-)brown in the fresh state, reminiscent of *Xanthophyllum ceraceifolium*, in which the petiole is still stouter and black. Two varieties are recognised in Borneo.

Key to varieties

Leaf base cordate or narrowly cordate, margins usually curved upwards.....

var. **adenotus**

Synonyms: *X. cordatum* Miq. *op. cit.* (1864) 274; Merrill, EB (1921) 325, Ridley, Bull. Misc. Inform. Kew (1925) 77; Chodat *op. cit.* (1929) 133; Masamune *op. cit.* 379; Anderson *op. cit.* (1980) 287; Beaman & Anderson *op. cit.* (2004) 263; *X. cordatum* Miq. f. *aequale* Chodat *op. cit.* (1929) 133, for the type only.

Sumatra and Borneo (Sabah, Sarawak, Brunei). In Sabah, common and widespread (e.g., *SAN 54118*, *SAN 73453*, *SAN 74178*, *SAN 95386*, *SAN 96533*, *SAN 126404* and *SAN 132039*) and in Sarawak recorded from Belaga, Bintulu, Kapit, Kuching, Lundu, Marudi, Miri, Song and Tatau districts (e.g., *Hansen 679*, *Jacobs 5450*, *S 22908*, *S 35070* and *S 64926*). Also known from Brunei (e.g., *BRUN 16253*, *BRUN 16592*, *BRUN 91176* and *Kirkup 357*). Lowland and hill mixed dipterocarp forest, frequently along river banks, on sandy soil or limestone-derived alluvial soil, from sea level to 700 m altitude.

Leaf base (rounded or) cuneate, margin flat.....

var. **arsatii** (C.E.C.Fisch.) W.J.de Wilde & Duyfjes

(After Arsat, a forest guard in Sabah)

Gard. Bull. Sing. 57 (2005) 47. Basionym: *X. arsatii* C.E.C.Fisch. *op. cit.* 176; Masamune *op. cit.* 379. **Type:** *Arsat BNBFD 1213*, Borneo, Sabah (holotype K).

Endemic in Borneo (Sabah, Sarawak, Brunei, Kalimantan). In Sabah, recorded from Kinabatangan, Labuk Sugut, Sandakan, Sipitang and Tawau districts (e.g., *SAN 37456*, *SAN 79073*, *SAN 91117*, *SAN 95970* and *SAN 130719*) and in Sarawak, from Kapit, Kuching, Lawas, Limbang, Lubok Antu, Lundu, Marudi and Miri districts (e.g., *Brooke 10035*, *S 29155*, *S 33564*, *S 34490* and *S 59969*). Also occurring in Brunei (e.g., *BRUN 15060*, *Hotta 13182*, *Niga NN 94*, *Ogata 142* and *Sands 5673*) and Kalimantan (e.g., *Church et al. 159*, *Endert 5078*, *Jarvie 5668*, *Mogea et al. 4036* and *Wiriadinata 3566*). Mixed dipterocarp forest, along streams, on flat land or on ridges, on sandy soil, sandstone, shale or silty clay, at altitudes to 400 m.

2. *Xanthophyllum beccarianum* Chodat

(Odoardo Beccari, 1843–1920, Italian explorer and botanist)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Mém. Soc. Phys. Hist. Nat. Genève, Suppl. (1891) t. 9, f. 3 ('*beccarianum*'), Bull. Herb. Boiss. 4 (1896) 257; Merrill *op. cit.* (1921) 325; Masamune *op. cit.* 325; Anderson *op. cit.* (1980) 286; Meijden *op. cit.* (1982) 112, *op. cit.* (1988) 522; Coode *et al.* (eds.) *op. cit.* 255. **Lectotype** (Meijden, 1982): *Beccari 2230*, Borneo, Sarawak (G; isoelectotypes K, M, SAR, W).

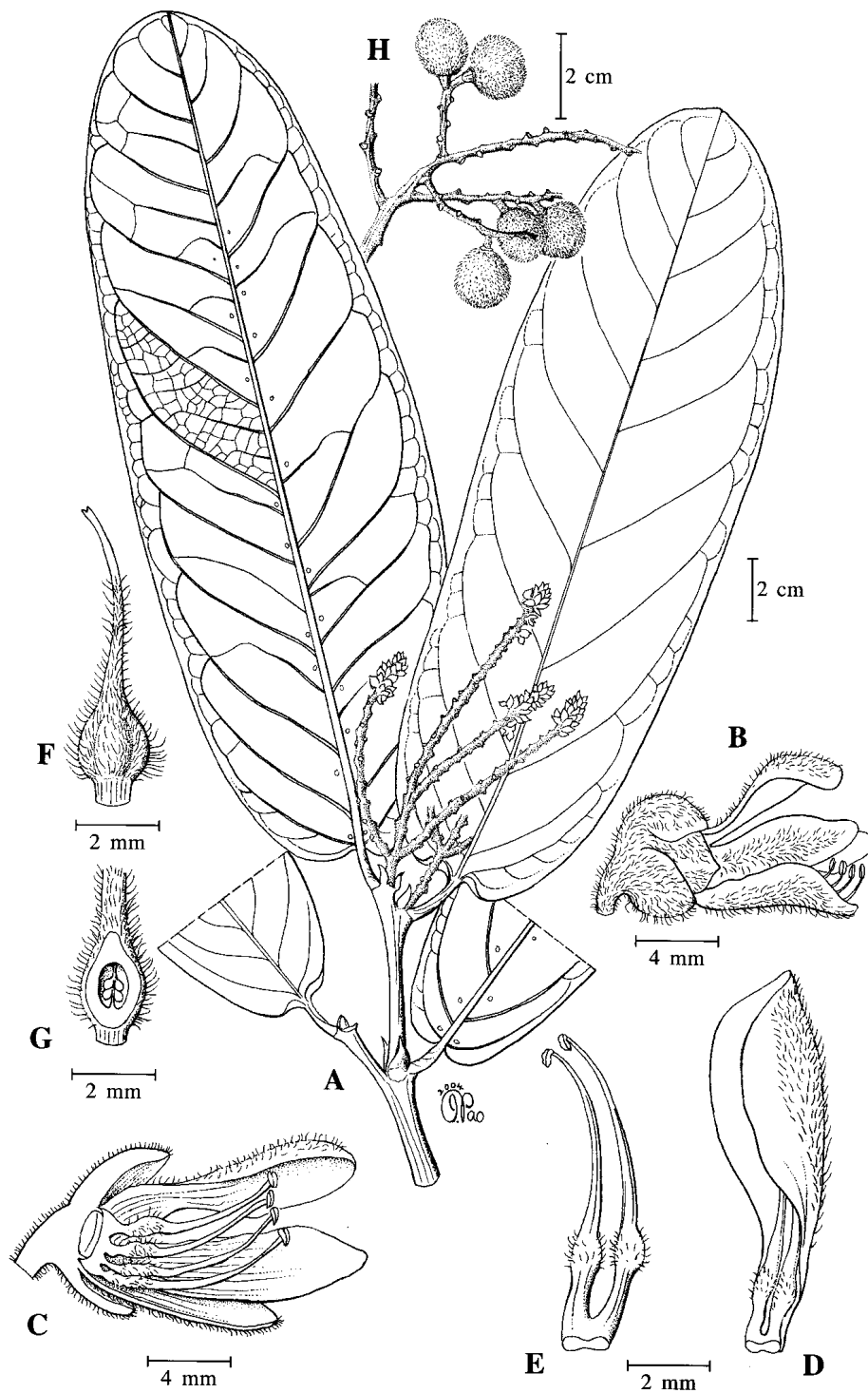


Fig. 1. *Xanthophyllum adenotus*. A, flowering leafy twig; B, open flower; C, longitudinal section of open flower with the gynoecium removed; D, lower petal with 2 stamens; E, stamens; F, gynoecium; G, longitudinal section of ovary; H, part of infructescence. (A–G from SAN 107296, H from SAN 81178.)

Tree, to 12 m tall, to 17 cm diameter. **Bark** grey (green), smooth. **Twigs**, without nodal glands, 2–3 mm diameter, densely patently hairy (hairs up to 1 mm long). **Axillary buds** solitary, long-hairy, triangular, 0.5–5 mm long, basally strongly thickened. **Leaves** discoloured, flat above, sparsely patently long-hairy and papillose below; blades narrowly elliptical, 9–19 × 4–8 cm, base cordate, apex acutish; midrib densely hairy below, slightly raised above; lateral veins 6–8 pairs, forming an indistinct intramarginal vein in apical part; intercostal venation reticulate; glands numerous, scattered, c. 0.1 mm diameter; petioles 3–6 mm long, smooth, densely long-hairy, without glands. **Inflorescences** unbranched, shorter than the leaves, densely minutely hairy (hairs to 0.4 mm long), flowers sometimes turned upside-down, basal part of axis bearing clustered flowers (to 3 together). **Flowers:** pedicels 7–10(–15) mm long; sepals glabrous or short-hairy; outer sepals c. 2.5 mm long, with glandular spots, inner sepals 3–4 mm long; petals 15–16 mm long, orange-red when dry, glabrous except for the ciliate base, the longest one c. 16 mm long; filaments free, anthers c. 2 mm long; ovary patently hairy, style glabrous in apical half, stigma slightly 2-lobed, ovules 13. **Fruits** globose, c. 1.5 cm diameter, finely hairy, apically pointed when immature; fruiting pedicels 10–12 mm long. **Seed** 1.

Distribution. Endemic in Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah, known by 1 collection from Labuk Sugut district, Bt. Masasau (*SAN 107390*) and in Sarawak from Bako NP, G. Gading NP, Sampadi FR, Samunsam WS, G. Santubong and Semengoh FR, all in Kuching district (e.g., *S 12781*, *S 14903*, *S 32986*, *S 34392*, *S 43446* and *S 69066*). In Brunei, recorded by one collection (*Wong WKM 1380*) from Temburong district and in Kalimantan known by 2 collections, one from Berau (*Ambriansyah et al. AA 665*) and the other from Ulu Barito (*Ridsdale PBU 7*).

Ecology. Mixed dipterocarp forest on ridges or along rivers, at altitudes to 200 m.

Notes. *Xanthophyllum beccarianum* is closely related to *X. brachystachyum*, *X. pedicellatum*, *X. purpureum*, *X. reticulatum* and *X. trichocladum*, forming the ‘beccarianum-group’, of which species delimitation needs further study.

3. *Xanthophyllum bicolor* W.J.de Wilde & Duyfjes

(Latin, *bi* = two, *color* = colour; referring to the different colour of the petiole and leaf surfaces)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Gard. Bull. Sing. 57 (2005) 48. **Type:** *Niga NN 182*, Borneo, Brunei, Belait district, Sg. Mau (holotype KEP; isotypes BRUN, L, SAN, SAR, SING).

Tree, to 30 m tall and 32 cm diameter. **Bark** dark brown, smooth; inner bark pale yellow. **Twigs** smooth, glabrous, grey, without nodal glands. **Axillary buds** solitary or in clusters of up to 3, conical, 2–4 mm long, glabrous, with corky thickenings at the base. **Leaves** discoloured, glabrous, flat, green and shiny above, contrastingly pale cinnamon and papillose below; blades oblong, 14–35 × 4.5–10 cm, base long-attenuate and forming part of the petiole, apex rounded to bluntly acute; midrib somewhat raised above; lateral veins 8–12 pairs, indistinct, basal veins hardly reaching the middle of the leaf, intramarginal vein faint; intercostal venation coarsely reticulate, faint; glands inconspicuous; petioles 20–30 mm long, glabrous, consisting of a grey-brown, transversely or longitudinally furrowed or wrinkled basal half and a smooth distal part, yellowish like the midrib, without glands.

Inflorescences nearly half as long as the leaves, 6–11 cm long, *unbranched*; *axes minutely sparsely appressed hairy*, *hairs 0.1–0.5 mm long*, 15–25-flowered; bracts minute. **Flowers:** 1–3 per bract; *pedicels 5–10 mm long*, appressed fine-hairy or subglabrous; sepals *c. 4 mm long*, subglabrous; petals glabrous, yellowish orange when fresh, brown-orange on drying; *filaments free*; ovary ovoid, *c. 4 mm diameter*, *sparsely appressed short-hairy*, *c. 2 mm stipitate*, style caducous, *stigma slightly 2-lobed*, *ovules 8(?)*. **Fruits** globose, 1.5–2 cm diameter, 2 mm stipitate, light brown (blue when fresh), glabrous; pericarp thin; fruiting pedicels *c. 10 mm long*. **Seed 1.**

Vernacular name. Brunei—*bait musang* (Iban).

Distribution. Endemic in Borneo (Sabah and Brunei). In Sabah, recorded from Beaufort and Ranau districts (e.g., *SAN 43595*, *SAN 77790* and *SAN 86129*). In Brunei, known from Belait district (e.g., *BRUN 17868*, *BRUN 17936*, *Joffre JJA 10*, *Niga NN 182* and *Niga NN 369*).

Ecology. Mixed dipterocarp forest, riverside forest or hills, on peaty or (yellow) sandy clay soil, at low altitude.

Notes. *Xanthophyllum bicolor* is close to *X. penibukanense* but the latter differs from the former in having smaller leaves with much shorter transversely wrinkled petioles.

4. *Xanthophyllum borneense* Miq.

(of Borneo)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Ann. Mus. Bot. Lugd.-Bat. (1864) 277; Merrill *op. cit.* (1921) 325; Masamune *op. cit.* 379; Anderson *op. cit.* (1980) 287; Meijden *op. cit.* (1982) 82, *op. cit.* (1988) 508. **Lectotype** (Meijden, 1982): *Korthals s.n.*, Borneo, Kalimantan (L [Acc. No. 9081711927]; isoelectotypes G, K, L [Acc. Nos. 944354123 & 9081711939], U [Acc. No. 40587], W). **Synonym:** *X. glabrescens* Ridl., Bull. Misc. Inform. Kew (1938) 113, Masamune *op. cit.* 380.

Small tree, to 5(–8) m tall. **Twigs** *reticulately wrinkled*, *without nodal glands*. **Axillary buds** *in clusters of 2 (or 3)*, *1–2(–3) mm long*, *glabrescent*. **Leaves** *subcoriaceous*, *concolorous or discolorous*, *glabrous*, *flat or slightly bullate* and *green(-brown) above*, *pale, not or (indistinctly) papillose below*; *blades elliptical-oblong*, *8–16 × 3.5–7 cm*, *base attenuate*, *apex acutish or acute-acuminate*, *margin sometimes undulate*; *midrib flat or prominent above*; *lateral veins 4–6(–8) pairs*, *forming an intramarginal vein*; *intercostal venation reticulate*; *glands few or numerous*, *scattered*, *c. 0.2 mm diameter*; *petioles 5–11 mm long*, *glabrous*, *finely transversely wrinkled*, *without glands*. **Inflorescences** *slender*, *axes 1–2 mm diameter*, *with less than 10 flowers*, *shorter or longer than the leaves*, *4–9 cm long*, *unbranched*, *glabrous*. **Flowers:** *pedicels c. 2 mm long*; sepals glabrous outside, outer sepals *c. 3 mm long*, inner sepals *c. 4 mm long*; petals pale brownish or orange when dry, minutely ciliate apically, the longest petal 10–11 mm long, keel sparsely appressed minutely hairy outside; *filaments free*, *anthers c. 0.3 mm long*, (sub)glabrous; *ovary glabrous or hairy all around*, style sparsely more or less appressed hairy, *stigma slightly 2-lobed*, *ovules 4*. **Fruits** globose to broadly ovoid, *1.5–1.8 cm diameter*, *pale brown*, *on drying smooth or coarsely wrinkled*, *glabrous or sparsely appressed hairy all around*; fruiting pedicels *c. 5 mm long*. **Seed 1.**

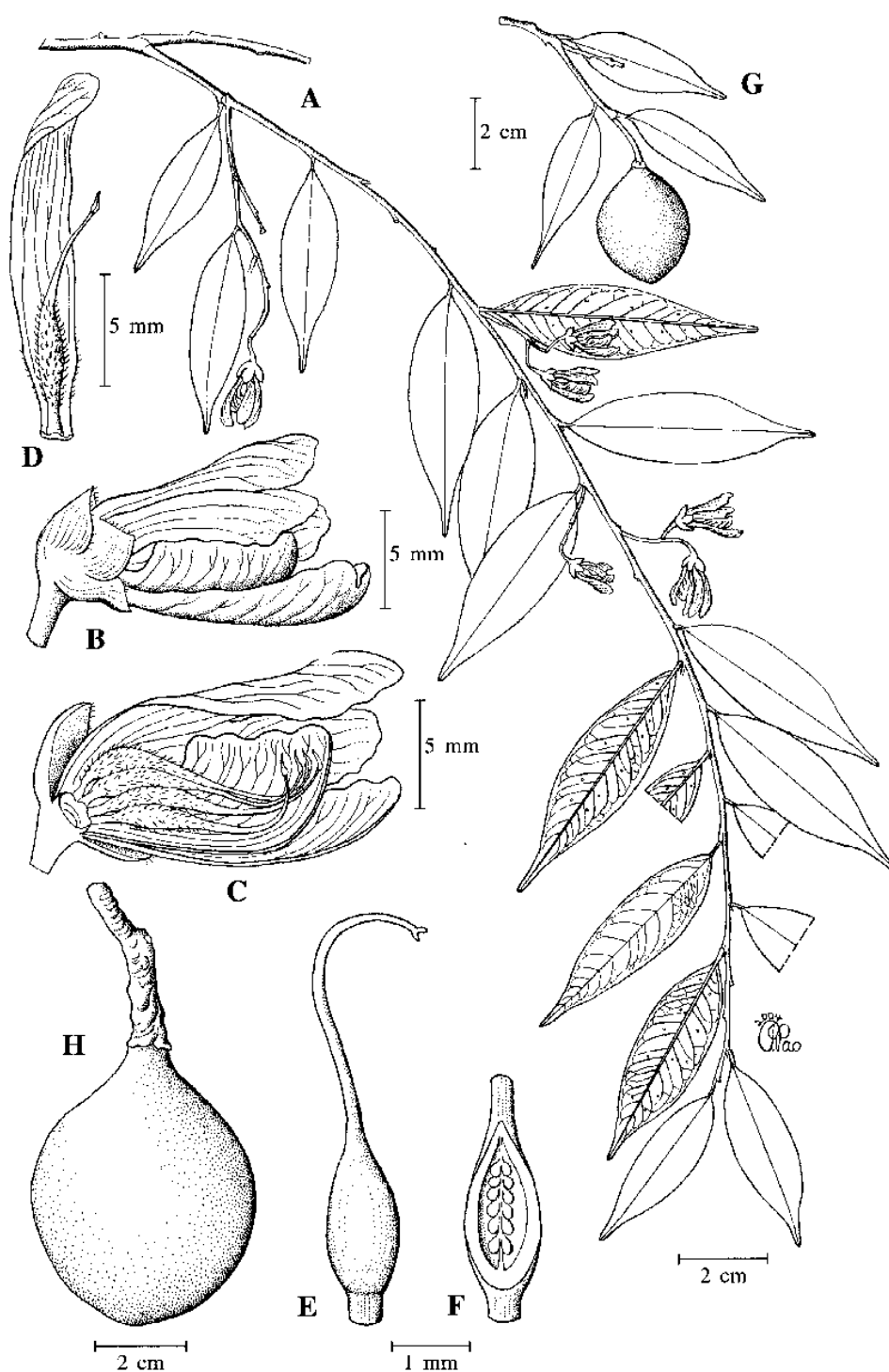


Fig. 2. *Xanthophyllum brevipes*. A, flowering leafy twig; B, open flower; C, longitudinal section of open flower with the gynoecium removed; D, adaxial view of stamen and petal; E, gynoecium; F, longitudinal section of ovary; G, part of leafy twig with immature fruit; H, mature fruit. (A–F from S 26838, G from S 32989, H from S 91156.)

Distribution. Endemic in Borneo (Sabah, Sarawak and SE Kalimantan) and known from few collections only. In Sabah, known by two rather doubtful collections, one from Beaufort district (*SAN 115308*) and the other from Lamag, Kinabatangan district (*SAN 53303*); and in Sarawak, recorded from Kapit and Kuching districts (e.g., *Hose 38* and *S 8451*). In SE Kalimantan, known only from the type.

Ecology. Forest along riverbanks, and on hillslopes, at altitudes below 300 m.

Notes. The circumscription of this species, comprising only few specimens collected from distant localities, needs further study.

5. *Xanthophyllum brachystachyum* W.J.de Wilde & Duyfjes

(Greek, *brachus* = short; *stachus* = spike; referring to the short inflorescences)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Gard. Bull. Sing. 57 (2005) 49. **Type:** *Normaya & Sirukit S 91521*, Borneo, Sarawak, Marudi district, Sg. Silat Basin, Bt. Palutan (holotype SAR; isotypes KEP, L, SAN, SING).

Tree, to 12 m tall and 9 cm diameter. **Bark** smooth, grey-green or whitish, slash bark yellow, tough. **Sapwood** yellow, hard. **Twigs** smooth, without nodal glands, 0.5–1 mm diameter, brown patently long-hairy, hairs c. 0.5 mm long, later glabrescent. **Axillary buds** solitary, less than 1 mm long, hairy. **Leaves** more or less discolorous, flat, green and glabrous above, patently long-hairy mainly on midrib and papillose below; blades narrowly oblong, 3–7(–9.5) × 0.5–1(–2) cm, base narrowly rounded or cuneate, apex long-acute; midrib flat above; lateral veins 4–7 pairs, forming a faint intramarginal vein; intercostal venation reticulate; glands numerous, scattered, minute, c. 0.1 mm diameter; petioles c. 2 mm long, long-hairy, smooth, without glands. **Inflorescences** much shorter than the leaves, c. 0.5 cm long, unbranched, 2–4-flowered; axes glabrescent, hairs c. 0.5 mm long. **Flowers:** pedicels 2–4 mm long, subglabrous; sepals sparsely appressed hairy or subglabrous, hairs c. 1 mm long, outer sepals 1.5–2 mm long, inner sepals c. 2.5 mm long; petals pale purplish, drying orange brown, (sub)glabrous, c. 12 mm long; filaments free, subglabrous, anthers c. 0.5 mm long, with some hairs at base; ovary c. 1 mm stipitate, densely light brown half-patently hairy, hairs 0.5–1 mm long, style glabrous in apical part, stigma slightly 2-lobed, ovules (presumably) 8 or more. **Fruits** globose, 1–1.5 cm diameter, pale brown, hairy; fruiting pedicels c. 5 mm long. **Seed** 1.

Vernacular names. Sarawak—*bagok* (Iban), *bila* (Kenyah), *nyalin daun kecil* (Malay).

Distribution. Endemic in Borneo (Sabah and Sarawak). In Sabah, known by one collection from Bt. Sunggau, Beaufort district (*SAN 77425*, which is intermediate with delicate forms of *X. purpureum*). In Sarawak, known from Marudi and Miri districts, (e.g., *S 3735*, *S 91521* and *S 91825*).

Ecology. Mixed dipterocarp forest, at 500–900 m altitudes.

6. *Xanthophyllum brevipes* Meijden

Fig. 2, Plate 7A.

(Latin, *brevis* = short, *pes* = foot or stalk; referring to the short-petioled leaves)

(subgen. **Brunophyllum**)

Bot. J. Linn. Soc. 67 (1973) 117, *op. cit.* (1982) 144, *op. cit.* (1988) 536; Anderson *op. cit.* (1980) 287; Argent *et al.* (eds.) *op. cit.* 505. **Type:** Anderson S 26838, Borneo, Sarawak, Kuching district, Semengoh FR (holotype L; isotypes KEP, L, SAN, SAR).

Tree, 20(–30) m tall, to 40 cm diameter. **Bark** smooth or slightly fissured, yellowish brown. **Twigs and branches** smooth, glabrous, green, pendent; nodal glands sometimes distinct. **Axillary buds** absent or if present minute, less than 0.5 mm long. **Leaves** glabrous, flat and (green-)brown above, hardly paler and papillose below; blades narrowly elliptical, 2.5–7.5 × 0.7–2.5 cm, base rounded or attenuate, apex acuminate to cuspidate; midrib sunken above; lateral veins c. 10 pairs, little more distinct than finer veins, forming an indistinct intramarginal vein; intercostal venation reticulate; glands more than 10, in a row between margin and midrib, c. 0.1 mm diameter; petioles 1.5–3 mm long, glabrous, finely transversely wrinkled, without glands. **Inflorescences** short, unbranched, 2–5-flowered; axes hardly thicker than pedicels, glabrous. **Flowers:** pedicels c. 7 mm long; sepals minutely ciliate at margin, for the rest glabrous, outer sepals c. 3.5 mm long, inner sepals c. 4 mm long; petals unequal, white, drying orange-brown, faintly ciliate, longest one 15–16 mm long, keel clawed, boat-shaped, ciliate at base; filaments c. 0.5 mm connate, hairy in basal part, anthers c. 1 mm long, glabrous; ovary orange-brown, glabrous, style glabrous, stigma peltate, ovules 18. **Fruits** glabrous, pear-shaped (to broadly ovoid), 4–5 cm diameter, strongly finely wrinkled when dry, shiny, (reddish) brown or blackish; pericarp firm; fruiting pedicels 10–15 mm long, blackish. **Seeds** more than 10, flattened-ovoid, c. 1 cm long.

Distribution. Endemic in Borneo (Sarawak and Brunei). In Sarawak, recorded from Bintulu, Kuching, Miri and Serian districts (e.g., S 15107, S 15748, S 16643, S 38492 and S 91155). In Brunei, known from Bt. Puan and Sg. Liang, Belait district (e.g., BRUN 631 and Ogata Og-B 404).

Ecology. Mixed dipterocarp forest, on slopes or near streams, at altitudes below 100 m.

Uses. *Xanthophyllum brevipes*, with sharply drooping branches, is potentially an ornamental roadside tree.

7. *Xanthophyllum ceraceifolium* Meijden

Fig. 3, Plate 7B.

(Latin, *ceraseus* = waxy, *folium* = leaf; referring to the waxy appearance of the leaves)

(subgen. **Xanthophyllum**, sect. **Eystathes**)

Bot. J. Linn. Soc. 67 (1973) 117, *op. cit.* (1982) 102, *op. cit.* (1988) 517, Anderson *op. cit.* (1980) 287. **Type:** Galau S 14822, Borneo, Sarawak, Kuching district, Semengoh FR (holotype L; isotypes K, SAN, SAR, SING).

Small tree, to 16 m tall, to 16 cm diameter. **Bark** greyish brown with numerous brown lenticels on lower trunk. **Twigs** smooth, without nodal glands, glabrous, greenish. **Axillary buds** solitary, half-patent, elliptical to oblong, 5–7 mm long, glabrous. **Leaves** coriaceous, glabrous, flat, dull greenish and rather glossy above, not papillose below; blades lanceolate-oblong, 22–50 × 7–18 cm, base broadly cuneate, apex acute-acuminate; midrib raised above; lateral veins 8–10 pairs, slightly prominent, in apical part forming an indistinct intramarginal vein; intercostal venation reticulate, obscure; glands 2–8, of which two at the

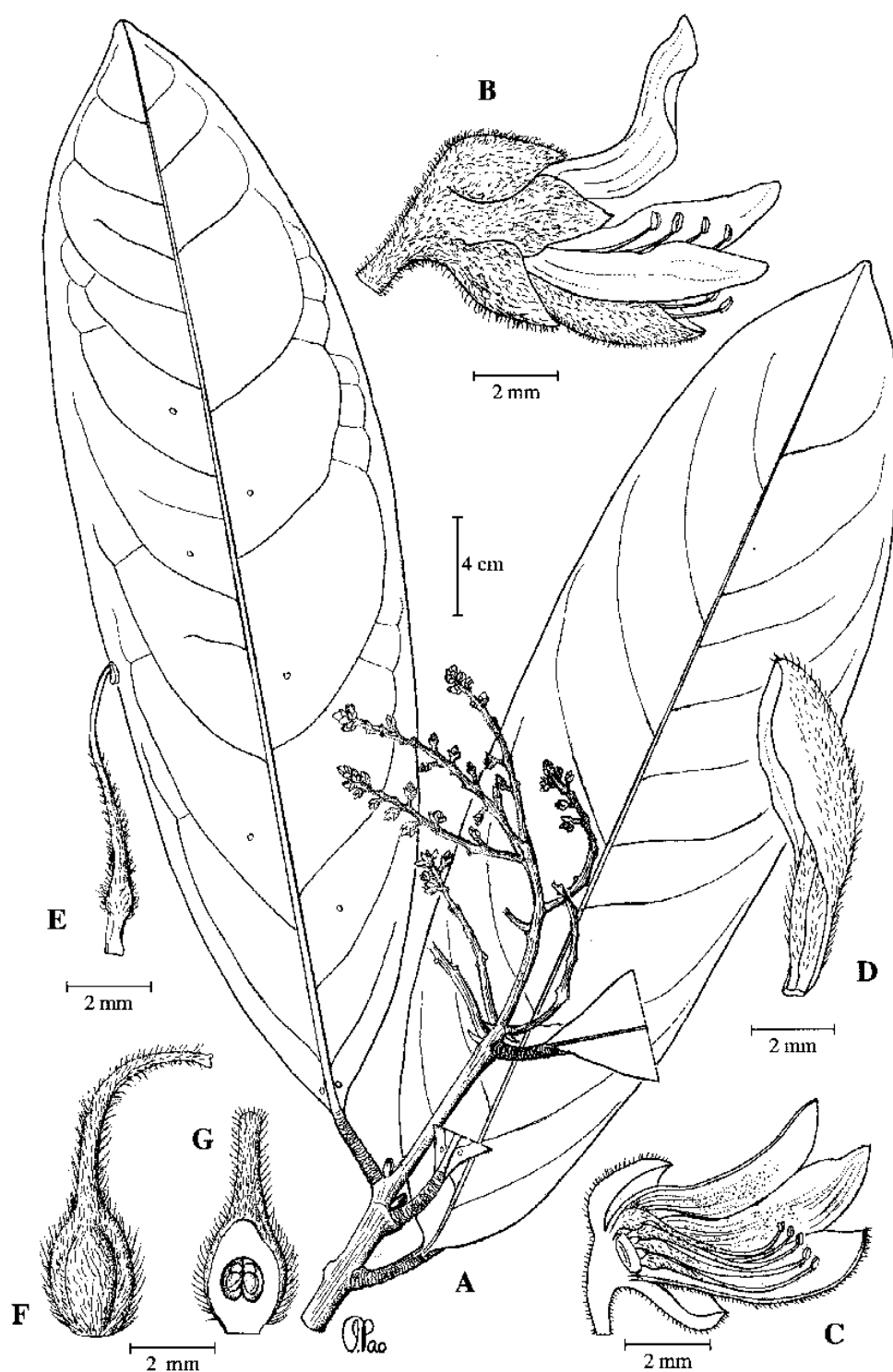


Fig. 3. *Xanthophyllum ceraceifolium*. A, flowering leafy twig; B, open flower; C, longitudinal section of open flower with the gynoecium removed; D, lower petal; E, stamen; F, gynoecium; G, longitudinal section of ovary. (All from S 32405.)

very base, 0.5–1 mm diameter, the other ones (if present) scattered, sometimes close to midrib; *petioles* (18–)25–30 mm long, *glabrous*, *black*, *stout*, *transversely wrinkled*, *without glands*. **Inflorescences** shorter than the leaves, *branched*; axes flattened basally, brown, minutely hairy; lower bracts (sub)opposite. **Flowers:** pedicels 2.5–3.5 mm long; outer sepals 3–3.5 mm long, inner sepals 4.5–5 mm long; petals yellowish, drying dark red, glabrous inside, the longest one 9–11 mm long, keel appressed hairy outside; *filaments free*, widened above base and with an appressed hairy knob-like thickening at inner side, anthers 0.5–1 mm long; *ovary* nearly sessile, *appressed long-hairy all around*, *stigma slightly 2-lobed*, *ovules 4*. **Fruits** unknown.

Distribution. Endemic in Borneo. Confined to Sarawak; known only from few collections from Semengoh FR (e.g., *S 14822*, *S 32449*, *S 37757*, *S 38742* and *S 91157*).

Ecology. Lowland mixed dipterocarp forest, on hillslopes, on sandy loamy soils.

Notes. In living as well as in dried specimens, the stout petiole is conspicuously black and transversely wrinkled.

8. *Xanthophyllum clovis* (Meijden) Meijden

Fig. 4.

(French, *clou* = nail; referring to the clove-like axillary buds)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Leiden Bot. Ser. 7 (1982) 103, *op. cit.* (1988) 517; Coode *et al.* (eds.) *op. cit.* 255. **Basionym:** *X. vitellinum* var. *clovis* Meijden *op. cit.* (1973) 120. **Type:** *Wood SAN 15156*, Borneo, Sabah, Sipitang district, Sibubu (holotype L; isotypes BRI, K, SING).

Tree, to 16 m tall, to 19 cm diameter. **Bark** greyish, with scattered lenticels, flaky. **Sapwood** yellow to reddish. **Twigs** (young) *smooth*, *glabrous*, yellowish green, without nodal glands. **Axillary buds** *solitary*, *clove-shaped*, *sessile*, 6.5–12 mm long, at base slightly enlarged and convex, *enlarged at the rounded or emarginate apex*, and there with 2 knob-like appendages. **Leaves** *glabrous*, *concolorous or discolorous*, *flat* and greenish to brownish above, *papillose below*; *blades elliptical*, 8.5–18 × 3.5–6.5 cm, *base broadly cuneate*, apex short acute-acuminate; midrib flat above; *lateral veins 7–8 pairs*, *forming an indistinct intramarginal vein in apical half*, *intercostal venation reticulate*; *glands few to numerous*, *mostly near the midrib*, 0.2–0.5 mm diameter; *petioles 9–20(–30) mm long*, *glabrous*, *finely transversely wrinkled*, *without glands*. **Inflorescences** to 20 cm long, *branched*; axes dark, minutely patent hairy, in basal part flowers in clusters of up to 7; lower bracts opposite. **Flowers:** pedicels 4–5 mm long, densely shortly more or less appressed hairy; outer sepals *c.* 3 mm long, inner sepals *c.* 4 mm long, with tiny glandular spots at apex; petals dark red when dry, the longest one 8.5 mm long, keel appressed hairy outside, other petals glabrous or sparsely ciliate; *filaments (almost) free*, widened above base and with appressed hairy, knob-like appendage at inner side, anthers *c.* 0.5 mm long; *ovary* subsessile, *half-patently hairy all around*, style hairy in two rows to near apex, *stigma slightly 2-lobed*, *ovules 4*. **Fruits** globose, 1.5–2 cm diameter, *glabrescent*; fruiting pedicels *c.* 5 mm long. **Seed** 1.

Distribution. Endemic in Borneo (Sabah, Sarawak, Brunei and E Kalimantan). In Sabah uncommon, known only by 2 collections from Labuk Sugut and Sipitang districts (i.e., *SAN 15156* and *SAN 99867*) and in Sarawak from Lundu and Miri districts (e.g., *S 49888* and *S*

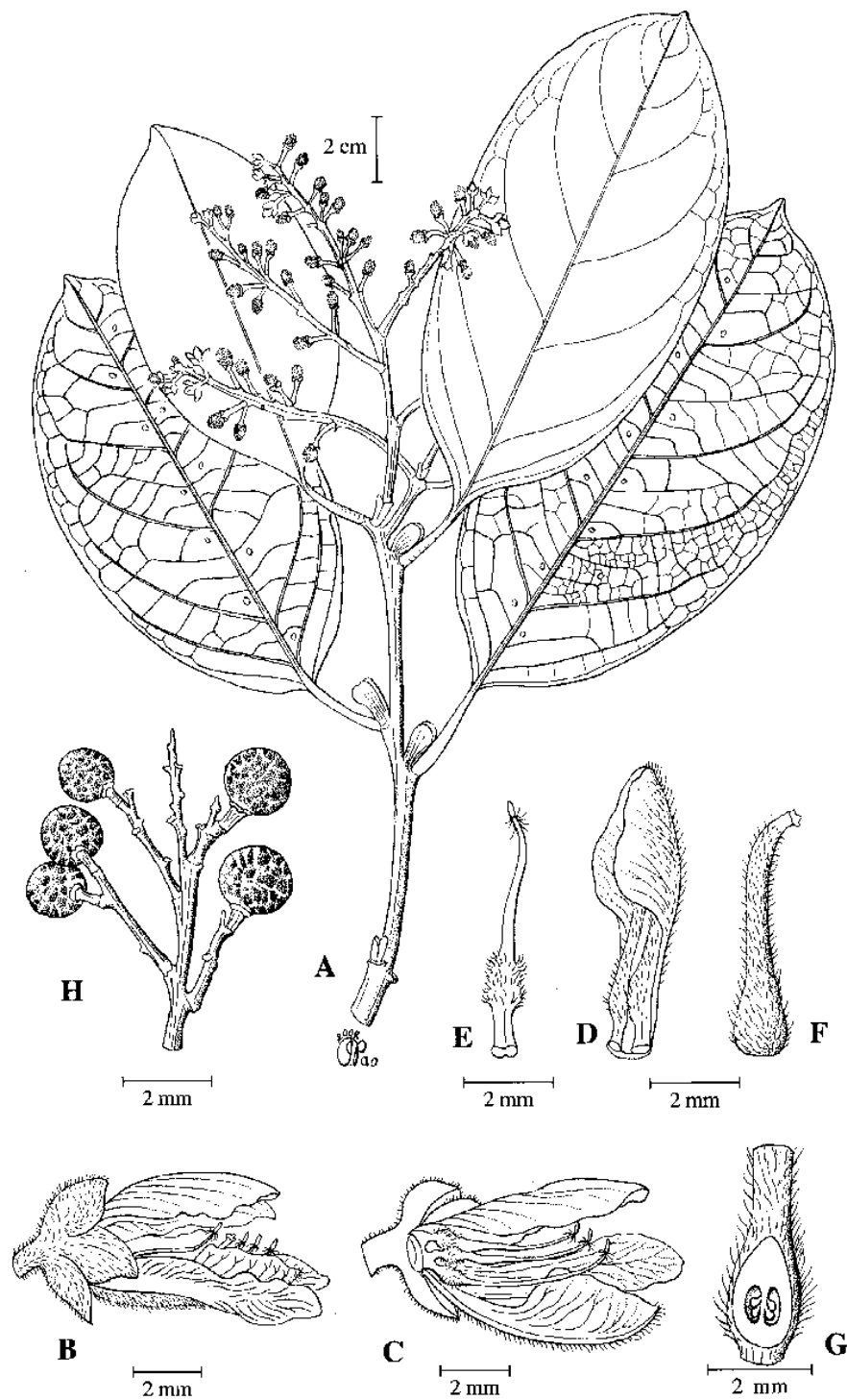


Fig. 4. *Xanthophyllum clovis*. A, flowering leafy twig; B, open flower; C, longitudinal section of open flower with the gynoecium removed; D, lower petal with 2 stamens; E, stamen; F, gynoecium; G, longitudinal section of ovary; H, infructescence. (A–G from S 49888, H from BRUN 16523.)

46563). Also occurring in Brunei, Tutong district (e.g., *Ariffin et al. ARK 18, BRUN 16523* and *Forman 8684*) and E Kalimantan (e.g., *Arifin Berau 1004*).

Ecology. Lowland mixed dipterocarp forest on hillsides or ridges and in Brunei in swamp forest.

Uses. Fruits are recorded as edible (*Ariffin et al. ARK 18*).

9. *Xanthophyllum contractum* Meijden

(Latin, *contractus* = contracted; referring to the short inflorescences and short stipitate fruits)

(subgen. **Triadelphum**)

Leiden Bot. Ser. 7 (1982) 138, *op. cit.* (1988) 532. **Type:** *Clemens 21664*, Borneo, Sarawak, Batang Rejang (holotype A; isotypes K, NY, SAR, Z).

Tree, c. 18 m tall, c. 30 cm diameter. **Twigs** smooth, pale yellowish, glabrous, with nodal glands. **Axillary buds** solitary, minute, obtuse, c. 1 mm long or smaller, glabrous. **Leaves** chartaceous, glabrous, flat and yellowish green above, not papillose below; blades elliptical-oblong, 14–20 × 6.5–8 cm, base acute, apex obtuse to very shortly acuminate; midrib raised above; lateral veins 8–9 pairs, not forming an intramarginal vein; intercostal venation scalariform; glands 12–18, located at 2–5 mm from the margin, some scattered, 0.2–0.3 mm diameter; petioles 9–10 mm long, glabrous, smooth, without glands. **Inflorescences** to 6 cm long, unbranched, appearing on older twigs from adventitious buds; nodal glands indistinct. **Flowers** unknown. **Fruits** c. 3 mm stipitate, ovoid, 1.5–2 × 1–1.5 cm, more or less fleshy, finely pustulate, dark reddish, glabrous; pericarp hard; fruiting pedicels 2–6 mm long, glabrous. **Seed** 1, (sub)apical, developing from one of the 12 opposite ovules in the apical half as seen in the young fruit.

Distribution. Endemic in Borneo. In Sarawak known by the type from Upper Rejang R., Belaga district (*Clemens 21664*), and another collection from Ulu Katibas, Song district (*S 64876*). In Brunei, represented by one collection (*Hotta 13348*) from Temburong district.

Ecology. Lowland riparian forest.

Notes. Fruits purple when ripe.

10. *Xanthophyllum discolor* Chodat

Plate 7C.

(Latin, *discolor* = of different colour; the upper and lower leaf surface)

(subgen. **Xanthophyllum**, sect. **Eystathes**)

Bull. Herb. Boiss. 4 (1896) 257; Ridley *op. cit.* (1922) 147; Ng *op. cit.* 356; Meijden *op. cit.* (1982) 108, *p.p.* (excl. syn. *X. hypoleucum*), *op. cit.* (1988) 520, *p.p.* (excl. syn. *X. hypoleucum*); Turner *op. cit.* 405; Coode *et al.* (eds.) *op. cit.* 255; Beaman & Anderson *op. cit.* 264. **Type:** Ridley 6199, Singapore (holotype K; isotypes BM, K). **Synonyms:** *X. discolor* Chodat subsp. *macranthum* Meijden *op. cit.* (1973) 118.

Distribution. Peninsular Malaysia, Borneo and the Philippines.

Notes. Two subspecies, subsp. *discolor* and subsp. *macranthum* Meijden, are recognised, with the latter occurring only in the Philippines.

subsp. **discolor**

Shrub or small tree, to 5 m tall, to 5 cm diameter. **Bark** whitish green. **Twigs** *smooth, without nodal glands, at apex 1–1.5 mm thick*, pale, whitish or yellowish, early glabrescent (hairs *c.* 0.1 mm long). **Axillary buds** *solitary*, ovate, 1–2 mm long, subacute or obtuse, pale brown, subglabrous. **Leaves** *discolorous, flat and* (brown-)green above, *glabrous or sometimes with minute hairs on midrib, pale and papillose below; blades narrowly ovate, 5–14 × 1.5–5 cm, base rounded or cuneate*, apex subobtuse, acute, or acute-acuminate (or short-caudate); midrib almost flat; *lateral veins 5–8 pairs, not forming an intramarginal vein* (or only a faint one in apical leaf half); *intracostal venation reticulate*; glands numerous, scattered, 0.1–0.2 mm diameter; *petioles (4–)8–12 mm long, transversely wrinkled, glabrous, without glands*. **Inflorescences** shorter than the leaves, 1.5–4.5 cm long, bearing 6–15 solitary flowers, *unbranched*; axes minutely hairy; bracts minute, caducous. **Flowers:** pedicels 2–4 mm long, subglabrous; sepals *c.* 2 mm long, partly minutely grey-hairy; petals 10–11 mm long, subglabrous, drying pink-orange; *filaments free*, slightly protruding, anthers not seen; *ovary c.* 1.5 mm stipitate, *densely appressed hairy*, style densely or sparsely more or less patently hairy, remaining on the growing ovary, *stigma slightly 2-lobed, ovules 4 or 8*. **Fruits** globose, 1–1.2 cm diameter, (sparsely) appressed hairy; pericarp thin, pale brown; fruiting pedicels *c.* 5 mm long. **Seed** 1.

Distribution. Peninsular Malaysia and Borneo (Sabah, Sarawak and Kalimantan). In Sabah, recorded from Kinabatangan, Labuk Sugut, Lahad Datu, Sandakan and Tawau districts (e.g., *FRI 41254*, *SAN 60113*, *SAN 82408*, *SAN 94028* and *SAN 129708*) and in Sarawak from Bau, Bintulu, Kapit, Lundu, Song and Sri Aman districts (e.g., *S 4694*, *S 46344*, *S 47342*, *S 50058* and *S 77595*). In Kalimantan, known from W and E parts (e.g., *ANU 26774*, *Enderi 3271*, *Kato et al. B 6115*, *Kostermans 7122* and *Wiradinata ITTO/BB 136*).

Ecology. Mixed dipterocarp forest, lower montane forest and *padang* forest, on hill summit and hill ridge, at 180–1100 m altitudes.

Uses. For Sarawak, *Awa et al. S 50058* reported: ‘for driving away padi pests burn the twigs into ashes and scatter it around the padi field’.

Notes. First developing leaves, when still dangling, are purple. Specimens from Peninsular Malaysia are recorded as having ovaries with 6–15 ovules (Ng *op. cit.* 1972, Meijden *op. cit.* 1982, *op. cit.* 1988); in the few Bornean collections either 4 or 8 ovules were counted. The number of ovules per ovary, as a strong taxonomic character needs, at least in certain species-groups, reconsideration.

11. *Xanthophyllum ecarinatum* Chodat

Plate 7D.

(Latin, *e* = without, *carinatum* = keeled; referring to the lack of a boat-shaped carina)

(subgen. **Brunophyllum**)

Bull. Herb. Boiss. 4 (1896) 254, in Engler & Prantl, Nat. Pflanz. Fam. III, 4 (1896) 344; Merrill *op. cit.* (1921) 325; Masamune *op. cit.* 379; Meijden *op. cit.* (1982) 148, *op. cit.* (1988) 539; Coode *et al.* (eds.) *op. cit.* 255; Argent *et al.* (eds.) *op. cit.* 505; Beaman & Anderson *op. cit.* 264. **Type:** Haviland 1768, Borneo, Sarawak (holotype K; isotype SAR). **Synonym:** *X. kalimantanum* Meijden *op. cit.* (1973) 118, *op. cit.* (1982) 148, *op. cit.* (1988) 539 (see notes).

Tree, 3–25 m tall, to 16 cm diameter. **Bark** pale grey (brown), smooth. **Sapwood** pale yellow. **Twigs** smooth, without nodal glands, glabrous. **Axillary buds** solitary, minute, less than 0.5 mm long, or absent. **Leaves** glabrous, flat, glossy and brown above, not papillose below; blades (ovate-)oblong, (3–)7–17 × (1–)2.5–7 cm, base rounded or attenuate, apex acuminate to cuspidate; midrib slightly prominent to flat, or sunken in basal part; lateral veins 5–7 pairs, forming a rather indistinct intramarginal vein; intercostal venation coarsely reticulate; glands 0–8, scattered in middle and apical parts of the leaf blade, 0.2–0.4 mm diameter; petioles (1.5–)4–6.5 mm long, glabrous, transversely wrinkled, without glands. **Inflorescences** (much) shorter than the leaves, unbranched; axes lanate (woolly hairy); flowers solitary or in basal part in clusters of up to 3. **Flowers** drying black; pedicels 2–6 mm long, sparsely lanate; outer sepals (3–)4–5 mm long, inner sepals (3.5–)6–7 mm long; petals subequal, 9.5–12 mm long, when fresh white, the upper ones with a yellow spot, ciliate towards apex, inside hairy above insertion of filaments; stamens 8(–10), shorter than petals, filaments for 5–6 mm connate, towards apex lanate, anthers c. 0.6 mm long, glabrous or sparsely lanate at base; ovary stipitate for 2.5–4 mm, drying black, glabrous or with few long hairs on the ribs, style glabrous or sparsely lanate, stigma peltate, ovules 12–18(–23). **Fruits** (sub)ellipsoid, 7–11 × 6 cm, attenuate at base and apex, orange to dark brown, glabrous; pericarp soft, c. 0.5 cm thick and coarsely wrinkled when dry; fruiting pedicels 5–10 mm long, 5 mm thick or more. **Seeds** 8 or more.

Vernacular names. Sarawak—*apolah* (Kayan), *buah kong* (Iban, Ulu Engkari).

Distribution. Endemic in Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah common, known from Keningau, Kinabatangan, Ranau, Tambunan, Tawau and Tenom districts (e.g. KEP 80476, Pereira JTP 154, SAN 84003, SAN 97683, SAN 100129, SAN 135858 and SAN 139755) and in Sarawak from Belaga, Bintulu, Kapit, Kuching, Lubok Antu, Lundu and Miri districts (e.g., S 8288, S 43917, S 46687, S 57679 and S 80899). Also occurring in Brunei (e.g., Dransfield JD 7410) and Kalimantan (e.g., bb. 17946, Church *et al.* 2728, Wiriadinata 3586 and Winkler 2464).

Ecology. Lowland mixed dipterocarp and lower montane forest, along rivers, on hillsides or steep slopes, also in *kerangas* forest, at altitudes to 1250 m. Occasionally occurs on ultrabasic soil.

Uses. The fruit, yellow or bright orange when ripe with white sweet pulp, is reported as edible.

Notes. The status of *Xanthophyllum kalimantanum* Meijden (*op. cit.* 1982, *op. cit.* 1988) from SE Kalimantan as a synonym needs further study, because its type is rather reminiscent of *X. parvifolium*.

12. *Xanthophyllum ellipticum* Miq. (Latin, *ellipticus* = elliptical; the leaves)

Fig. 5.

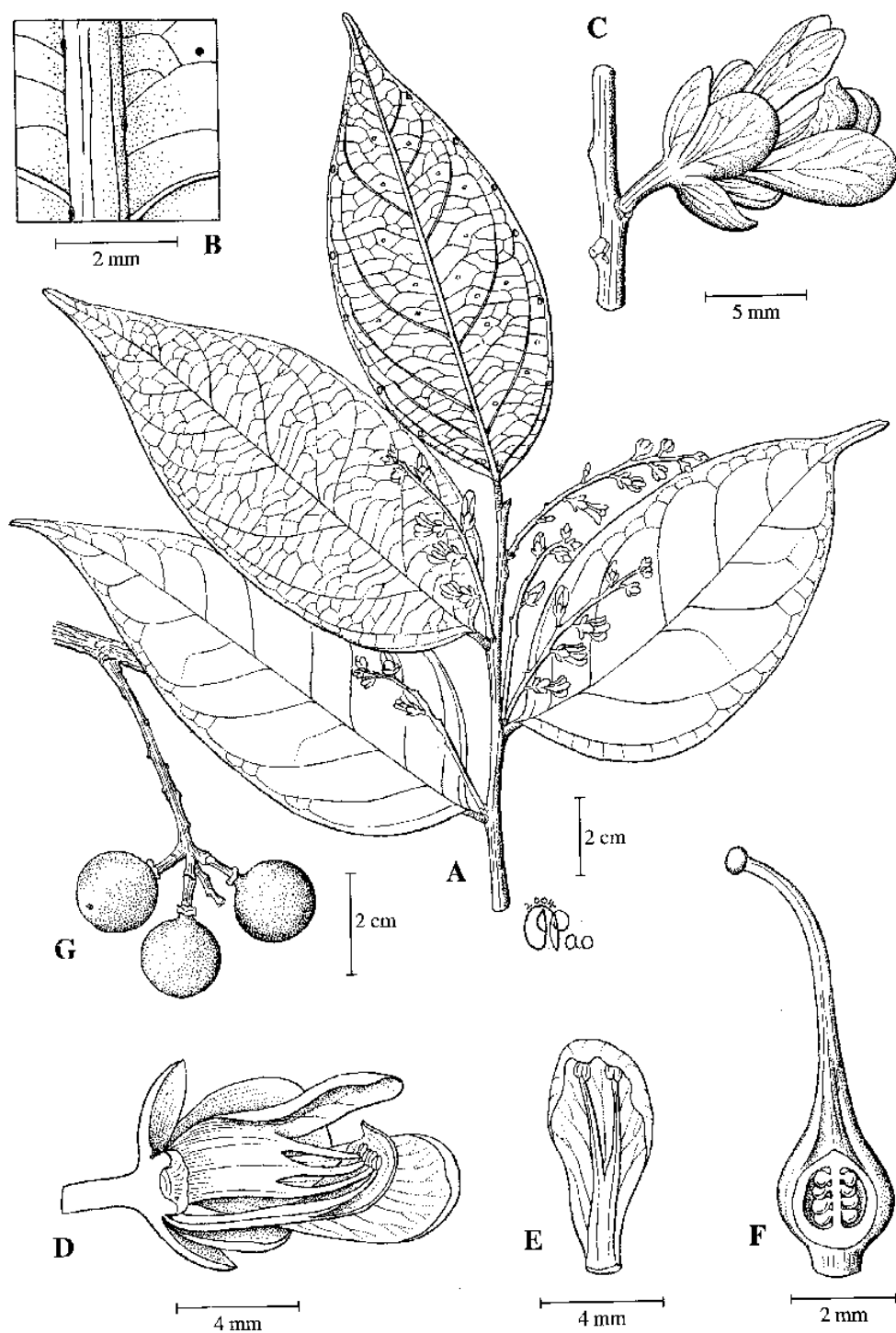


Fig. 5. *Xanthophyllum ellipticum*. A, flowering leafy twig; B, detail of lower leaf surface with glands; C, open flower; D, longitudinal section of open flower with the gynoecium removed; E, adaxial view of petal and stamens; F, gynoecium with longitudinal section of ovary; G, infructescence. (A–F from S 25564, G from S 53089.)

(subgen. **Triadelphum**)

Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 276; King *op. cit.* 140; Chodat *in* Engler & Prantl, Nat. Pflanz. Fam. III, 4 (1896) 344, *op. cit.* (1929) 133 (excluding var. *subcoriaceum*); Merrill *op. cit.* (1921) 326; Masamune *op. cit.* 379; Ng *op. cit.* (1972) 357; Anderson *op. cit.* (1980) 287; Meijden *op. cit.* (1982) 135, *op. cit.* (1988) 530; Turner *op. cit.* 405; Coode *et al.* (eds.) *op. cit.* 255; Argent *et al.* (eds.) *op. cit.* 505; Pendry, *op. cit.* 526. **Lectotype** (Meijden, 1982): *Korthals s.n.*, Borneo, Kalimantan (L [Acc. No. 9081711971]; isoelectotypes AMD [Acc. Nos. 036920 & 036919], G, L [Acc. No. 9081711909]). **Synonyms:** *X. citrifolium* Chodat, Bull. Herb. Boiss. 4 (1896) 255, *in* Engler & Prantl (1896) 345, Merrill *op. cit.* (1921) 325, Masamune *op. cit.* 379, Anderson, Gard. Bull. Sing. 20 (1963) 152; *X. kingii* Chodat, Bull. Herb. Boiss. 4 (1896) 255; Ridley *op. cit.* (1922) 143.

Shrub or tree, to 30 m tall, to 40 cm diameter. **Bark** grey or reddish brown, smooth. **Sapwood** (white-)yellow. **Twigs** glabrous or minutely short-hairy, *smooth, with distinct nodal glands*. **Axillary buds** solitary, *c. 1 mm long*, inconspicuous. **Leaves** glabrous, flat and green or pale brownish *above, not papillose below; blades ovate-elliptical, 5–20 × 2–7 cm, base cuneate, apex acute-acuminate, margin sometimes shallowly crenate because of glands; midrib narrow and sunken above; lateral veins 5–9 pairs, forming a distinct intramarginal vein; intercostal venation reticulate; glands numerous, 0.4–0.8 mm diameter, scattered but at least 6 present on the leaf margin itself; petioles 4–7 mm long, glabrous or minutely hairy, longitudinally or transversely wrinkled, without glands*. **Inflorescences** sometimes several together, shorter than the leaves, *unbranched*. **Flowers:** *pedicels 3–4 mm long, sparsely to densely minutely (woolly) hairy; sepals often drying black, glabrous or minutely hairy inside, outer sepals 3–4 mm long, inner sepals 4–5(–6) mm long; petals white or pale yellow, drying brown or dark orange, inside minutely hairy above base, keel 6–7(–8) mm long, other petals 8–9 mm long, lateral petals 3–4 mm wide, upper petals 1.5–2 mm wide; stamens triadelphous, glabrous, anthers c. 0.5 mm long, short hairy at base, ciliolate along slits, often cohering around the stigma; ovary subsessile, glabrous, black when dry, style glabrous, stigma peltate, ovules 8–14. Fruits globose, 1.5–2.2 cm diameter, smooth, (brown or) blackish when dry (orange when fresh), somewhat shiny, glabrous; pericarp thin, brittle, inside purplish red; fruiting pedicel 3–6(–8) mm long. Seed 1.*

Vernacular names. Sarawak—*nyalin tikus* (preferred name), *apolah* (Kayan), *kayu paya* (Kenyah). Brunei—*bait, menjalin* (Iban).

Distribution. S Thailand, Sumatra, Peninsular Malaysia, Singapore, Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah common, recorded from Beaufort, Keningau, Kuala Penyu, Papar, Penampang, Ranau, Sandakan, Tambunan, Tawau and Tenom districts (e.g., *SAN 27321, SAN 49361, SAN 63183, SAN 66028, SAN 70024, SAN 79313 and SAN 132249*) and in Sarawak also common and known from Betong, Bintulu, Julau, Kuching, Marudi, Miri, Sarikei, Sibuan and Sri Aman districts (e.g., *S 11974, S 29857, S 35777, S 51759 and S 65118*). Also occurring in Brunei (e.g., *BRUN 15138, BRUN 15224, BRUN 16280 and Dransfield JD 7437*) and Kalimantan (e.g., *Church et al. 1582, Endert 1806, Kartawinata 1405 and Kostermans 10358*).

Ecology. Lowland forest, mainly in (peat) swamp forest and along rivers, at altitudes to 650 m. Occasionally also in *kerangas* forest (e.g., *S 11974*).

13. **Xanthophyllum ferrugineum** Meijden

(Latin, *ferrugineus* = rusty coloured; the inflorescences)

(subgen. **Xanthophyllum**, sect. **Xanthophyllum**)

Bot. J. Linn. Soc. 67 (1973) 118, *op. cit.* (1982) 69, *op. cit.* (1988) 503; Anderson *op. cit.* (1980) 287; Coode *et al.* (eds.) *op. cit.* 257; Argent *et al.* (eds.) *op. cit.* 508. **Type:** *Au S 23906*, Borneo, Sarawak (holotype L; isotypes K, KEP, L, SAN, SAR, SING).

Tree, to 25 m tall, to 40(–60) cm diameter. **Bark** grey or greenish, smooth. **Sapwood** yellow. **Twigs** smooth, without nodal glands, glabrous. **Axillary buds** solitary, inconspicuous. **Leaves** coriaceous, glabrous, flat and bright yellow(–green) above, not papillose below; blades elliptical-oblong, 8–20 × 3–7 cm, base cuneate, apex acute-acuminate; midrib prominent to sunken above, not very prominent below; lateral veins 5–7 pairs, forming indistinct intramarginal vein; intercostal venation scalariform (exceptionally more or less reticulate), fine, obscure; glands few, mainly near the margin, 0.4–0.6 mm diameter, basal glands similar; petioles 9–14 mm long, glabrous, finely transversely wrinkled or smooth, without glands. **Inflorescences** shorter than the leaves, at the apex of twigs, branched; axes densely to sparsely yellow-brown short-hairy. **Flowers:** pedicels 1–2(–6) mm long, densely minutely greyish hairy; sepals brown with pale margin when dry, 4–5 mm long, (sub)glabrous outside, often with (minute) glandular spots, outer sepals sparsely minutely hairy, inner sepals thickened in middle basal part, minutely appressed hairy, but glabrous along the margin; petals yellow or white, the upper petals with a yellow spot, drying yellowish, the longest one 8.5–10 mm long, keel densely hairy outside and in apical part inside, other petals (sub)glabrous; filaments free, anthers 0.5–0.7 mm long, minutely hairy; ovary sometimes ribbed, glabrous (or sparsely hairy), apically often greyish hairy in 4 short rows, stigma slightly 2-lobed, ovules 8–14. **Fruits** subglobose, 1–2 cm diameter, finely tuberculate, dull, yellowish brown, glabrous (immature fruits with persistent sepals); fruiting pedicel c. 3 mm long. **Seed** 1.

Vernacular name. Sarawak—*senumpol* (Iban).

Distribution. Endemic in Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah, known from Kinabatangan, Kota Kinabalu and Tawau districts (e.g., *FRI 41304*, *SAN 42002*, *SAN 62907*, *SAN 62921* and *SAN 64058*) and in Sarawak from Kanowit, Kapit, Kuching and Limbang districts (e.g., *S 14975*, *S 23987*, *S 27054*, *S 29556* and *S 32263*). Also occurring in Brunei (e.g., *BRUN 3038*) and Kalimantan (e.g., *Nooteboom 4350*).

Ecology. Mixed dipterocarp forest, on ridges, on sandy clay soil, often on soil over ultrabasic bedrock, at altitudes to 500 m.

Notes. *Xanthophyllum ferrugineum* resembles *X. flavescens* (see below) but the latter differs from the former by its longer pedicels and more hairy sepals.

14. **Xanthophyllum flavescens** Roxb.

Fig. 6.

(Latin, *flavescere* = becoming yellowish; the leaves).

(subgen. **Xanthophyllum**, sect. **Xanthophyllum**)

Pl. Corom. 3 (1820) 82, t. 284, f. 2; Anderson *op. cit.* (1980) 287; Meijden *op. cit.* (1982) 64, *op. cit.* (1988) 500; Turner *op. cit.* 405; Coode *et al.* (eds.) *op. cit.* 256; Argent *et al.* (eds.) *op. cit.* 508. **Lectotype** (Meijden, 1982): *Roxburgh s.n.* [‘May, 1811; Sp. N. 363–p. 3034, *Xanthophylla flavescens*, this is a large tree, found on Thothoree hill, flowers all yellow’], India (BM). **Synonyms:**

Jakkia excelsa Blume, Bijdr. Fl. Ned. Ind. (1825) 62 ('*Jackia*'); *X. excelsum* (Blume) Miq., Fl. Ind. Bat. 1, 2 (1858) 129, Merrill *op. cit.* (1921) 326, Enum. Philip. Fl. Pl. 2 (1923) 386; Ridley *op. cit.* (1922) 143; Masamune *op. cit.* 380, Backer & Bakhuizen *f. op. cit.* 201, Ng *op. cit.* (1972) 354; *X. affine* Miq. *op. cit.* (1864) 271, King *op. cit.* 142, Ridley *op. cit.* (1922) 143, Merrill *op. cit.* (1923) 386, Chodat *op. cit.* (1929) 133, Masamune *op. cit.* 379, Ng *op. cit.* (1972) 354, Anderson *op. cit.* (1980) 286, Meijden *op. cit.* (1982) 70, *op. cit.* (1988) 503, Kessler & Sidiyasa *op. cit.* 193, Turner *op. cit.* 405, Coode *et al.* (eds.) *op. cit.* 255, Argent *et al.* (eds.) *op. cit.* 505, Beaman & Anderson *op. cit.* 264, **syn. nov. Lectotype** (Meijden, 1982): *Korthals s.n.*, Borneo (L [Acc. No. 9081711714]; isoelectotypes AMD [Acc. Nos. 036923 & 036924]); *X. sarawakense* Chodat, Bull. Herb. Boiss. 4 (1896) 262, Merrill *op. cit.* (1921) 326, Masamune *op. cit.* 381, **syn. nov. Type**: *Beccari 3459*, Borneo (holotype K; isotypes FI, K, P); *X. pallidum* Ridl., Bull. Misc. Inform. Kew (1938) 113, Masamune *op. cit.* 380. (For complete synonymy *cf.* Meijden *op. cit.* 1982).

Shrub, treelet, understorey or canopy tree, to 30 m tall and 50(–80) cm diameter. **Bark** grey or (greenish) brown, smooth. **Sapwood** (pale) yellow. **Twigs** smooth, without nodal glands, glabrous or minutely greyish hairy, glabrescent. **Axillary buds** solitary or in clusters of 2 or 3, conical, 0.5–4 mm long, glabrous or hairy, the upper one sometimes stalked or slightly supra-axillary. **Leaves** flat, yellowish or greyish green, often lighter along midrib and base of veins above, not papillose, glabrous or sometimes minutely hairy in basal part below; blades elliptical or oblong, rarely lanceolate, 5–18(–35) × 2–8(–13) cm, base attenuate to nearly rounded, apex acute (acuminate); midrib sunken or raised above, prominent below; lateral veins 4–10(–16) pairs, usually forming (incomplete or distinct) intramarginal vein; intercostal venation (sub)scalariform, exceptionally reticulate; glands absent or (1–)2–10, scattered, variable in size; petioles 5–15 mm long, glabrous, smooth, sometimes at apex or in apical half with two glands. **Inflorescences** at the upper part of twigs, shorter or longer than the leaves, single or few together, mostly branched, minutely greyish hairy, nodes or bracts sometimes with glands. **Flowers** single or 2 or 3 together; *pedicels* (2–)3–11 mm long; *sepals* persistent in fruit or not, hairy, sometimes with small glands, *outer sepals* 1.5–5.5 mm long, (sparsely or) densely hairy, inner sepals 2–7.5 mm long; petals yellow, or white (or rarely pink), the upper ones with or without a (orange-)yellow spot, drying yellowish, the longest one 6–17 mm long, keel and lateral petals mostly finely hairy outside, hairy or glabrous inside, upper petals reflexed, finely hairy sometimes only towards base; *filaments* free (or to 1 mm connate), glabrous or sparsely hairy towards base, anthers 0.5–1.5 mm long; *ovary* glabrous or greyish hairy on 2 or 4 ribs in apical part, often somewhat 2-locular, sometimes ribbed or tuberculate, style hairy, *stigma* slightly 2-lobed, *ovules* (5–)8–12(–16). **Fruits** globose or somewhat longer than wide, 1–2 cm diameter, sometimes sharply beaked, glabrous, smooth, sometimes ribbed, (pale) brown; pericarp not very thick, hard; fruiting *pedicels* 4–11 mm long. **Seeds** 1 (or 2).

Vernacular names. Sabah—*lahau* (Kadayan), *penatang* (Dusun Kinabatangan), *tampasak* (Ranau). Sarawak—*kabok* (Kayan), *lamie* (Kayan), *sabetong* (Punan). Brunei—*bait* (Iban).

Distribution. Continental SE Asia (E India, Bangladesh, Myanmar, Thailand, Laos, Cambodia, Vietnam) and W Malesia: Sumatra, Peninsular Malaysia, Java, Borneo (the most common species; Sabah, Sarawak, Brunei and Kalimantan) and the Philippines. In Sabah, recorded from most districts (e.g., *SAN 26071*, *SAN 30362*, *SAN 42805*, *SAN 95813* and *SAN 119229*) and in Sarawak also common and known from most districts (e.g., *S 29150*, *S 32945*, *S 47517*, *S 52777* and *S 77366*). Also occurring in Brunei (e.g., *BRUN 16229*, *BRUN 16860* and *Wong WKM 1372*) and Kalimantan (e.g., *bb. 18353*, *Burley 2477*, *Endert 3372*, *Kostermans 10142* and *Mogea et al. 4064*).

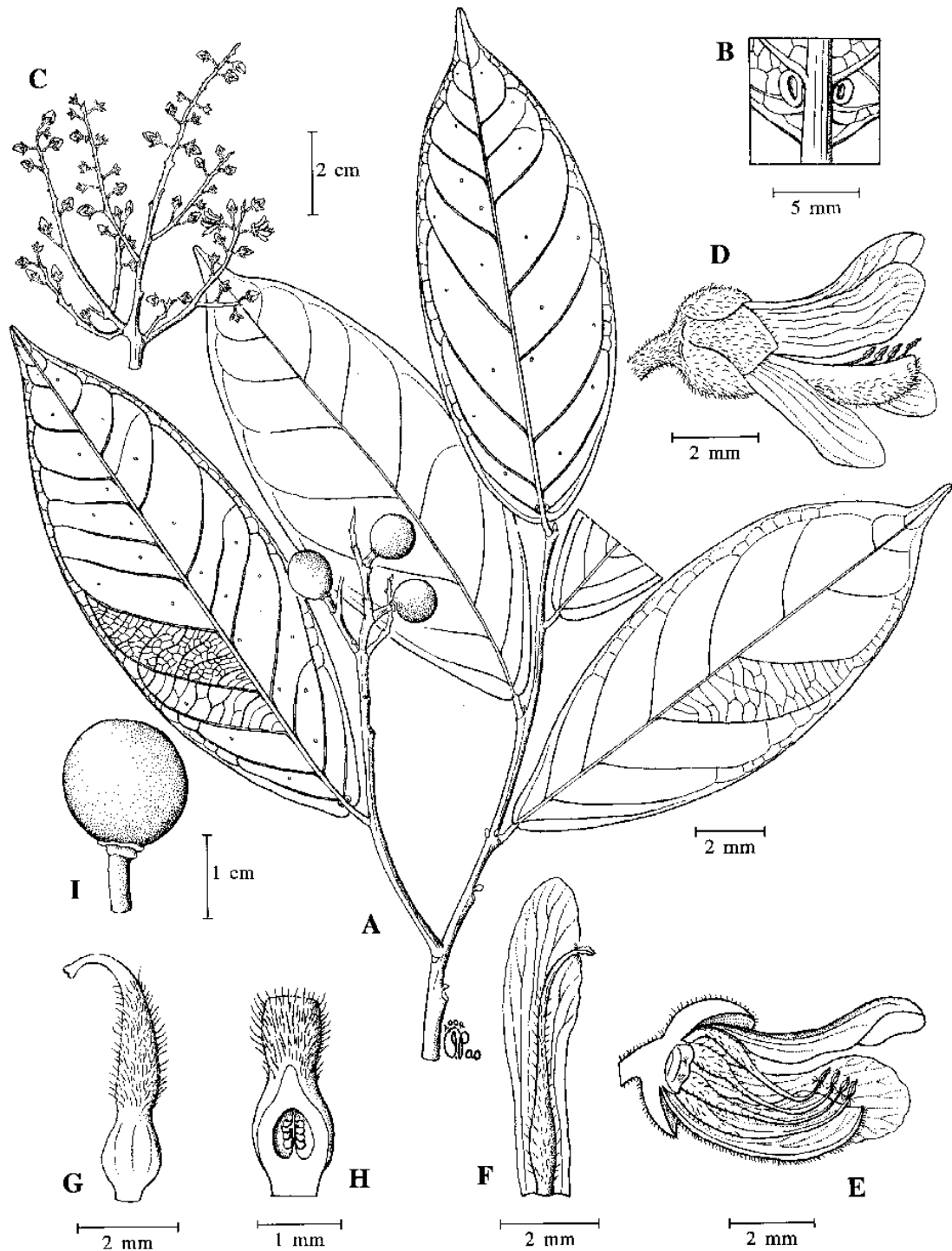


Fig. 6. *Xanthophyllum flavescens*. A, fruiting leafy twig; B, detail of lower leaf base with glands; C, inflorescence; D, open flower; E, longitudinal section of open flower with the gynoecium removed; F, adaxial view of petal and stamen; G, gynoecium; H, longitudinal section of ovary; I, fruit. (A–B from *S* 41080, C–H from *SAN* 30606, I from *S* 41080.)

Ecology. Mixed dipterocarp to montane forest at altitudes to 1500(–2000) m, on flat land, along streams or on ridges, on clay loam soil, sandy soils, sandstone, limestone, or soil over ultrabasic bedrock.

Uses. In Kalimantan the leaves are eaten as a vegetable (*Giessen 45*), and the wood for building houses (*Church et al. 93*).

Notes. *Xanthophyllum flavescens* is a very variable species, including specimens with leaves of variable shape and drying yellow or green. Some collections seem intermediate to related species, e.g., *X. ferrugineum*, *X. havilandii*, *X. macrophyllum* or *X. velutinum*.

15. *Xanthophyllum griffithii* A.W.Benn.

(W. Griffith, 1810–1845, British colonial physician and botanist in India and Malacca)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

In Hooker f., Fl. Br. Ind. 1 (1874) 210; King *op. cit.* 136; Ridley *op. cit.* (1922) 149; Ng *op. cit.* (1972) 357 (excl. var. *curtisii* and var. *montanum*), Mal. For. (1975) 85; Meijden *op. cit.* (1982) 92, *op. cit.* (1988) 513; Kessler & Sidiyasa *op. cit.* 194; Turner *op. cit.* 405; Coode *et al.* (eds.) *op. cit.* 256; Argent *et al.* (eds.) *op. cit.* 508; Pendry *op. cit.* 532; Beaman & Anderson *op. cit.* 265. **Lectotype** (Ng, 1972): *Griffith s.n.*, Myanmar, Mergui (K). **Synonyms:** *X. gracile* Chodat, Bull. Herb. Boiss. 4 (1896) 256; *X. parvum* Chodat, Bull. Herb. Boiss. 4 (1896) 264; *X. pseudostipulaceum* Merr., Philip. J. Sc. (1915) Bot. 316, *op. cit.* (1923) 387.

Tree, to 27 m tall and 40 cm diameter. **Bark** greyish or (blackish) brown, smooth. **Sapwood** (pale) yellow. **Twigs** smooth, slender, c. 1(–2) mm diameter, without nodal glands, glabrous or minutely patently short-hairy. **Axillary buds** solitary, sessile, half-patent, (1.5–)3–10 mm long, hairy, glabrous or glabrescent. **Leaves** glabrous, concolorous or discolorous, flat and dark green to brownish above, lighter coloured, glaucous or (sometimes) not glaucous and papillose or not papillose below; blades ovate, ovate-oblong or elliptical-oblong, 4–10 × 1–5 cm, base (broadly) cuneate, apex acute-acuminate, sometimes cuspidate; midrib flat or slightly raised above; lateral veins 4–6 pairs, usually forming an indistinct intramarginal vein in apical half; intercostal venation reticulate; glands 4–20, scattered but often located near midrib, 0.2–0.3 mm diameter; petioles 5–12 mm long, glabrous, finely transversely wrinkled, sometimes with 1 or 2 glands in apical part. **Inflorescences** up to 10 cm long, mostly branched; axes (reddish) brown, sparsely or densely minutely short-hairy, glabrescent or not; lower bracts opposite. **Flowers:** pedicels 1.5–4.5 mm long; sepals sometimes with 2 glands in apical part, outer sepals 1.5–2.5 mm long, inner sepals 2.5–3.3 mm long; petals white, the upper ones with a yellow spot, drying dark (orange-)red, the longest one 6.5–10 mm long, keel clawed, densely hairy outside, other petals glabrous or hairy outside in apical part; filaments free, widened above base and with a knob-like hairy appendage on inner side, anthers c. 0.4 mm long; ovary 0.5–2 mm stipitate, appressed hairy all around, stigma slightly 2-lobed, ovules 4. **Fruits** globose, 1–1.2 cm diameter, smooth, brown, hairy all around (sometimes glabrescent); fruiting pedicels 2–4 mm long. **Seed** 1.

Distribution. SE Asia and Malesia. A widespread species, of which in Sabah and Sarawak two varieties occur.

Key to varieties

Twigs at apex slender, c. 1 mm diameter or less, glabrous. Branches of inflorescences finely hairy, glabrescent.

var. **angustifolium** Ng

(Latin, *angustus* = narrow, *folium* = leaf; with narrowed leaves)

Fed. Mus. J., N. S. 13 (1970 [for 1968]) 137. **Type:** *Osman* KEP 23692, Peninsular Malaysia (holotype SING; isotype KEP). **Synonym:** *X. griffithii* A.W.Benn. subsp. *angustifolium* (Ng) Meijden *op. cit.* (1982) 94, *p.p.*, *op. cit.* (1988) 513, *p.p.*, Beaman & Anderson *op. cit.* 265.

Twigs early glabrescent or glabrous, towards apex c. 1 mm diameter or less. *Axillary buds* long-triangular, acute, 1.5–5 mm long, glabrous or early glabrescent. *Leaf blades* ovate-oblong or elliptical-oblong, 4–9 × 1–4(–5) cm, apex sometimes long-acuminate, usually paler, (indistinctly) papillose or not papillose below; petioles 5–10 mm long, glabrous. *Branches of inflorescences* slender, 1 mm thick or less, glabrescent. *Fruits* sparsely (more or less appressed) hairy (sometimes glabrescent); fruiting pedicels 3–4 mm long, glabrescent.

Peninsular Malaysia and Borneo. In Borneo, known in Sabah from Kinabatangan, Penampang, Ranau, Tambunan and Tawau districts (e.g., *SAN* 21929, *SAN* 44739, *SAN* 63066 and *SAN* 77483) and in Sarawak from Belaga, Kapit, Kuching, Limbang, Lundu and Mukah districts (e.g., *S* 29198, *S* 36705, *S* 48819, *S* 69812 and *S* 81817). Also occurring in Brunei (e.g., *Prance et al.* 30688). Usually in lower montane forest, occasionally also in lowland mixed dipterocarp forest on slopes and ridges, riparian forest and *kerangas* forest, at 200–1400 m altitudes.

Twigs towards apex 1–2 mm diameter, hairy. Branches of inflorescences hairy.

var. **papillosum** W.J.de Wilde & Duyfjes

(Latin, *papillosum* = papillose; the lower leaf surface)

Gard. Bull. Sing. 57 (2005) 52. **Type:** *Abang Mohtar* S 54289, Borneo, Sarawak, Lundu district (holotype SAR; isotypes K, KEP, L, MO, SAN). **Synonym:** *X. griffithii* A.W.Benn. subsp. *angustifolium* (Ng) Meijden *op. cit.* (1982) 94, *p.p.*

Twigs hairy, towards apex 1–2 mm thick. *Axillary buds* long-triangular or oblong-linear, 5–9(–10) mm long, hairy. *Leaf blades* (ovate or) elliptical-oblong, 5–10(–13) × 2–5 cm, apex acute-acuminate, dull, pale (grey-glaucous) and distinctly papillose below; petioles 6–12 mm long, hairy. *Branches of inflorescences* 1–2 mm thick, densely brown-hairy. *Fruits* densely patently hairy, sometimes glabrescent; fruiting pedicels c. 3 mm long, densely finely hairy.

Endemic in Borneo and known in Sarawak from Bintulu, Kuching and Lundu districts (e.g., *S* 40567, *S* 47097, *S* 54289, *S* 59990 and *S* 60111). Also occurring in E Kalimantan (e.g., *Ambriansyah et al.* 942 and *Kessler et al.* 651). In mixed lowland dipterocarp forest and heath forest, also in forest close to the sea.

16. **Xanthophyllum havilandii** Chodat

(G.D. Haviland, 1857–1901, surgeon and naturalist, Medical Officer and Director of Govt. Museum at Kuching, Sarawak)

(subgen. **Xanthophyllum**, sect. **Xanthophyllum**)

Bull. Herb. Boiss. 4 (1896) 260; Merrill *op. cit.* (1921) 326; Masamune *op. cit.* 380; Anderson *op. cit.* (1980) 287. **Type:** *Haviland* 1616, Borneo, Sarawak, Kuching (holotype K, *n.v.*). **Synonym:** *X. hosei* Ridl., Bull. Misc. Inform. Kew (1938) 113; Masamune *op. cit.* 380; Meijden *op. cit.* (1982) 69; *op. cit.* (1988) 502, **syn. nov.** **Lectotype** (Meijden, 1982): *Hose* 311, Borneo, Sarawak (K; isolectotypes BM, L).

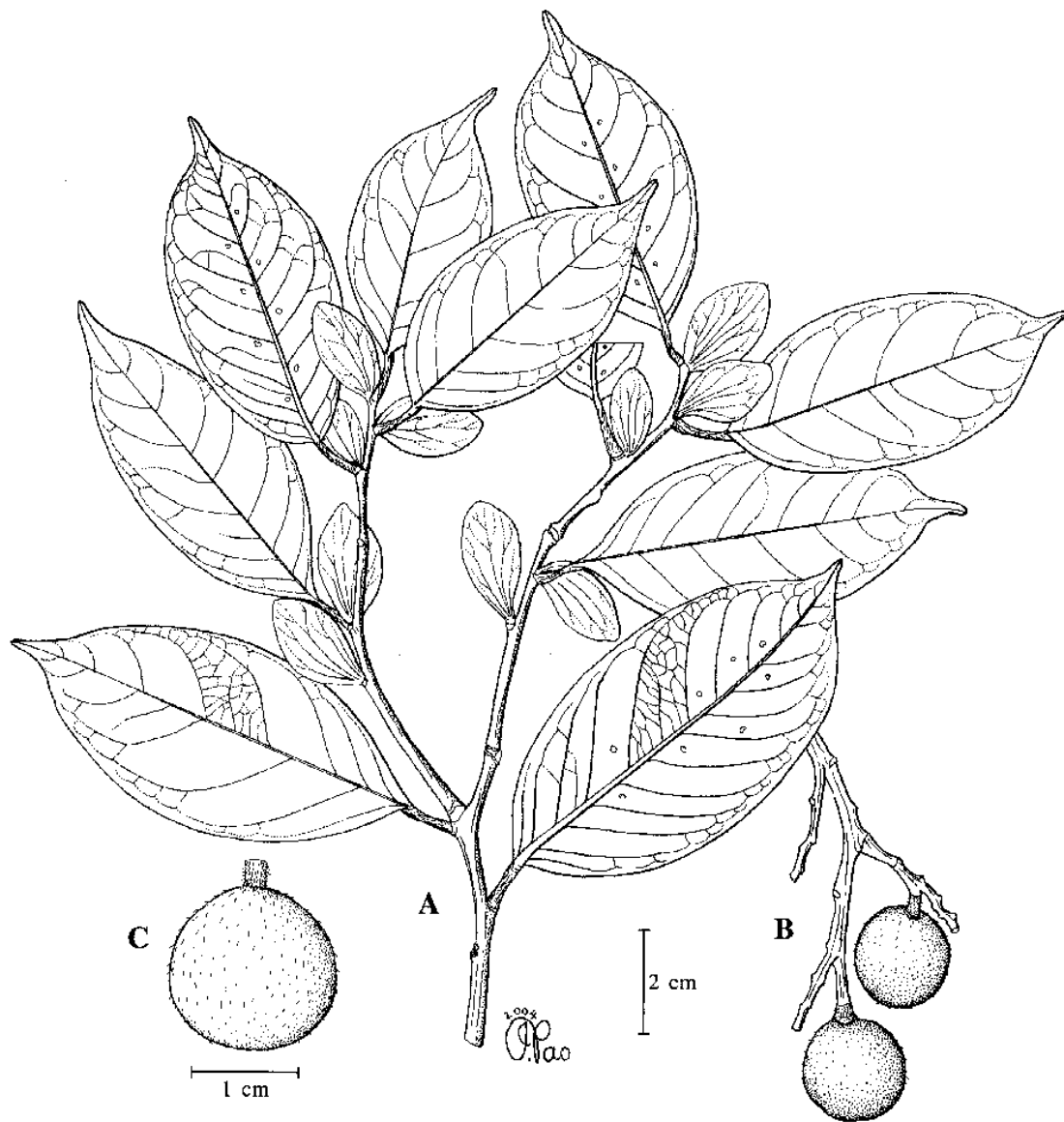


Fig. 7. *Xanthophyllum heterophyllum*. A, leafy twig; B, infructescence; C, fruit. (A from SAN 42728, B–C from SAN 25338.)

Shrub or small tree, to 5 m tall, to 6 cm diameter. **Bark** blackish. **Twigs** smooth, without nodal glands, glabrous or minutely appressed short-hairy, soon glabrescent. **Axillary buds** inconspicuous. **Leaves** slightly bullate between lateral veins, lower surface lighter coloured, not papillose, glabrous or sparsely minutely appressed short-hairy in basal part especially on the veins (hairs c. 0.2 mm long); blades elliptical-oblong, 12–21 × 4.5–10 cm, base rounded to short-cuneate, apex acuminate-cuspidate; midrib sunken above, prominent below; lateral veins 7–11 pairs, forming a distinct, (nearly) complete intramarginal vein; intercostal venation scalariform; glands 8 to numerous, scattered, 0.2–0.4 mm diameter, basal glands larger; petioles 7–12 mm long, minutely appressed short-hairy, smooth, without glands. **Inflorescences** borne on the upper parts of twigs, up to 12 cm long, branched or unbranched; axes often thickened, dull, minutely densely appressed short-hairy, internodes (except at base) very short, 0.5–1 mm long, resulting in the conspicuously dense-flowered inflorescence. **Flowers:** pedicels 2.5–4 mm long; sepals glabrous to sparsely minutely appressed hairy inside, outer sepals 2–2.5 mm long, with 2–4 glandular spots, appressed hairy outside, inner sepals 3.5–4 mm long, keeled and there densely appressed hairy, for the rest more or less glabrous outside; petals yellowish when dry, the longest one c. 8.5 mm long, keel clawed, sparsely hairy outside, glabrous inside, other petals glabrous but more or less ciliate; filaments free, wide at base, sparsely hairy to halfway, anthers c. 1 mm long, ciliate along slits; ovary subsessile, glabrous, smooth or ribbed, style glabrous in basal 1/3, upwards appressed hairy, stigma slightly 2-lobed, ovules 7–10. **Fruits** globose, c. 1.5 cm diameter, smooth or finely pustulate, glabrous; style more or less persistent, recurved; fruiting pedicels 3–4 mm long. **Seed** 1.

Distribution. Endemic in Borneo (Sarawak and Brunei). In Sarawak known from Belaga, Bintulu, Kuching and Miri districts (e.g., *Haviland 1616*, *Hose 311*, *S 14783*, *S 24911* and *S 27999*). In Brunei, recorded from Belait district (e.g., *Coode et al. 7814* and *Dransfield et al. 6848*).

Ecology. Mixed dipterocarp forest on hillsides or on river banks, at low altitudes.

Notes. There has been confusion about the identity of the names *Xanthophyllum havilandii* and *X. hosei*, but more recent collections, e.g., *Dransfield et al. 6848*, *Coode et al. 7814*, both from Brunei, made it clear that the types of both names belong to one species. The type of *X. havilandii* (*Haviland 1616*) belongs to the form with a branched inflorescence with rather well-spaced flowers, whereas the lectotype of *X. hosei* (*Hose 311*) represents the form with mostly unbranched inflorescences with the flowers conspicuously densely packed.

17. *Xanthophyllum heterophyllum* Meijden Fig. 7, Plate 8A. (Greek, *heteros* = different, *phullon* = leaf; referring to the leaf-like axillary buds)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Leiden Bot. Ser. 7 (1982) 107, *op. cit.* (1988) 519; Coode *et al.* (eds.) *op. cit.* 256; Argent *et al.* (eds.) 508; Beaman & Anderson *op. cit.* 265. **Type:** *Wood SAN 15371*, Borneo, Sabah (holotype L; isotypes BRI, KEP).

Tree, to 30 m tall and to 50 cm diameter. **Bark** greyish or yellowish, smooth, fissured or cracked. **Sapwood** white or (reddish) yellow, with large rays as of *Quercus*. **Twigs** smooth, 1–2 mm diameter, without nodal glands, glabrous. **Axillary buds** solitary, large, elliptical to oblong, (8–)10–20(–35) × 6–12(–14) mm; scales flat and leaf-like, wrinkled, indistinctly

veined, more or less shiny, sometimes in middle part with 1–4 indistinct glands, base shortly attenuate, apex rounded to obtuse. **Leaves** glabrous, flat, more or less shiny and brownish green above, yellowish brown, not papillose below; blades (narrowly) elliptical, 4–12(–19) × 2–5(–7.5) cm, base cuneate, apex shortly acuminate to cuspidate; midrib flat or raised above; lateral veins 7–10(–12) pairs, not forming an intramarginal vein; intercostals venation reticulate; glands few to many, mostly situated in the middle and apical parts of leaf blade, 0.2–0.4 mm diameter; petioles 7–15 mm long, glabrous, finely transversely wrinkled, without glands. **Inflorescences** branched, c. 5 cm long; axes densely short-hairy; lower bracts opposite. **Flowers** unknown (ovary appressed hairy all around, ovules 4). **Fruits** globose, c. 1.5 cm diameter, shiny or dull, brown, slightly hairy; pericarp soft; fruiting pedicels 1.5–3 mm long. **Seed** 1, and 3 abortive ovules.

Vernacular name. Sarawak—nyalin bukit (Iban).

Distribution. Endemic in Borneo (Sabah, Sarawak and Brunei). In Sabah, recorded from Beaufort, Kinabatangan, Kota Kinabalu, Labuk Sugut, Ranau and Sandakan districts (e.g., SAN 42011, SAN 62090, SAN 66624, SAN 69307, SAN 84133 and SAN 93048) and in Sarawak from Kuching district (e.g., Purseglove P4431 and S 8917). Also occurring in Brunei (e.g., BRUN 599).

Ecology. Lowland forest, hillsides and on ridges, at low altitudes (exceptionally to 1000 m).

18. *Xanthophyllum hildebrandii* Meijden

(F.H. Hildebrand, 1900–1975, Dutch forester and botanist)

(subgen. *Triadelphum*)

Leiden Bot. Ser. 7 (1982) 139, *op. cit.* (1988) 532; Beaman & Anderson *op. cit.* 265. **Type:** *Clemens* 26048, Borneo, Sabah, Mt. Kinabalu, Dallas (holotype L; isotype K).

Tree. **Twigs** smooth, with distinct nodal glands, glabrous. **Axillary buds** solitary, minute. **Leaves** membranous, glabrous, flat and dull above, reddish brown and not papillose below; blades (narrowly) elliptical, c. 15 × 5–7 cm, base attenuate, apex acute-acuminate; midrib sunken above; lateral veins c. 7 pairs, in apical half forming a rather indistinct intramarginal vein; intercostal venation coarsely reticulate; glands numerous, mostly located very close to midrib in the axils of the lateral veins, with a few scattered, 0.5–1 mm diameter; petioles c. 6 mm long, glabrous, smooth, without glands. **Inflorescences** 1 or 2 together, unbranched; nodal glands distinct; axes up to 10 cm long, sparsely shortly woolly hairy, basal bracts attenuate. **Flowers** unknown. **Fruits** (young) c. 2.5 mm stipitate, ovoid, apically with gland-like pustules, black, glabrous; fruiting pedicels 7–10 mm long, dark. **Seed** (immature) 1, (sub)apical, developing from one of c. 12 ovules situated in apical 2/3 of the fruit.

Distribution. Endemic in Borneo and known only from the type collection from Mt. Kinabalu, Sabah.

Ecology. Hill mixed dipterocarp forest, at c. 1000 m altitude.

Notes. The incompletely known *Xanthophyllum hildebrandii* is very similar to *X. ellipticum* in having some glands always present on the leaf margin.

19. *Xanthophyllum impressum* Meijden(Latin, *impressus* = impressed; referring to the enclosed axillary buds)(subgen. ***Xanthophyllum***, sect. ***Eystathes***)Leiden Bot. Ser. 7 (1982) 90, *op. cit.* (1988) 513; Argent *et al.* (eds.) *op. cit.* 508. **Type:** *Agam SAN 31500*, Borneo, Sabah, Lahad Datu district (holotype L; isotypes KEP, SAN, SAR).

Tree, to 23 m tall, to 70 cm diameter. **Bark** pale or dark grey, smooth. **Sapwood** white or yellowish. **Twigs** without nodal glands, yellowish, smooth, glabrous. **Axillary buds** solitary, mostly more or less enclosed between the base of the petiole and a low ridge of the twig, $1-2 \times 1.5-2$ mm, for c. 1 mm of its length uncovered; scales thickened, especially at base, but leaving a narrow scar. **Leaves** glabrous, mostly discolorous, flat and dull greyish green above, pale yellowish green and papillose below; blades narrowly elliptical, $10-20 \times 3.5-9$ cm, base cuneate, apex acutish to shortly acuminate; midrib prominent above; lateral veins 8-9 pairs, not forming an intermarginal vein; intercostal venation reticulate; glands scattered, inconspicuous, c. 0.3 mm diameter; petioles 10-14 mm long, glabrous, longitudinally or finely transversely wrinkled, sometimes with glands. **Inflorescences** to 20 cm long, branched, 6 (or more)-flowered; axes reddish brown, densely minutely appressed hairy; lower bracts (sub)opposite. **Flowers:** pedicels 1.5-4 mm long; outer sepals 2-2.5 mm long, inner sepals 3-4 mm long; petals white, the upper ones with a yellow spot, drying orange to dark red, the longest one 8.5-10.5 mm long, keel clawed, densely hairy outside, other petals glabrous; filaments free, widened above the base, there appressed hairy, for the rest glabrous, anthers c. 0.7 mm long, hairy or (sub)glabrous at base; ovary subsessile, half-patently hairy, stigma slightly 2-lobed, ovules 4. **Fruits** globose, c. 1.7 cm diameter, dull, smooth, pale brownish, appressed hairy; fruiting pedicels 3-4 mm long. **Seed** 1.

Distribution. Borneo (Sabah and E Kalimantan) and the Philippines. In Sabah, known from Beaufort, Kinabatangan, Lahad Datu and Ranau districts (e.g., *SAN 25091*, *SAN 39920*, *SAN 62958*, *SAN 77037* and *SAN 96580*). Also occurring in Kalimantan (e.g., *Kostermans 13665*).

Ecology. Forest on ridges or river banks, at low altitudes.

Notes. *Xanthophyllum impressum* resembles *X. vitellinum* but the latter differs from the former by its non-papillose lower leaf surface.

20. *Xanthophyllum korthalsianum* Miq.

(P.W. Korthals, 1807-1892, Dutch botanist)

(subgen. ***Xanthophyllum***, sect. ***Eystathes***)

Ann. Mus. Bot. Lugd.-Bat. (1864) 277; Anderson *op. cit.* (1980) 287; Meijden *op. cit.* (1982) 107, *op. cit.* (1988) 520; Argent *et al.* (eds.) *op. cit.* 510. **Lectotype** (Meijden, 1982): *Korthals s.n.*, Borneo, Kalimantan (L [Acc. No. 9081711711]); isolectotypes K, L [Acc. No. 9081711706], U [Acc. No. 40577]).

Tree, to 25 m tall, *c.* 30 cm diameter. **Twigs** glabrous, smooth, without nodal glands. **Axillary buds** solitary, inserted on the stem (1.5–)3–15 mm above the leaf axils, on 1–2 mm long stalks; scales leaf-like, elliptic to linear-lanceolate, 6–18 × 1.5–8 mm, faintly veined. **Leaves** glabrous, discolorous, flat and green above, papillose below; blades elliptical, 8–14 × 2.5–5 cm, base cuneate, apex acute-acuminate; midrib slightly raised above; lateral and intercostal veins prominent to obscure; lateral veins 6–8 pairs, forming a more or less distinct intramarginal vein; intercostal venation reticulate; glands few to numerous, located near the midrib or scattered, 0.1–0.3 mm diameter; petioles 7–10 mm long, glabrous, finely transversely wrinkled, glands present or absent. **Inflorescences** shorter to much longer than the leaves, branched, the lower branches distinctly supra-axillary, (sub)opposite; axes densely minutely hairy. **Flowers:** pedicels 1.5–2 mm long; sepals glabrous inside except for few hairs at base, outer sepals *c.* 2 mm long, inner sepals *c.* 3.5 mm long; petals incompletely known, upper petal *c.* 8.5 mm long, sparsely hairy at apex; stamens not seen; ovary patently whitish hairy (short and long fine hairs mixed), style and stigma not seen, ovules 4. **Fruits** unknown.

Distribution. A rare species, known from few collections from C Sumatra and Borneo (Sarawak and SE Kalimantan). In Sarawak, recorded from Bt. Raya, Kapit district (e.g., *S* 24806). Also occurring in SE Kalimantan (e.g., *Korthals s.n.*).

Ecology. Ridge forest, at *c.* 200 m altitude.

Notes. *Xanthophyllum korthalsianum* is similar to *X. heterophyllum* but the latter differs from the former by its non-papillose lower leaf surface and sessile, strictly axillary buds.

21. *Xanthophyllum lineare* (Meijden) W.J.de Wilde & Duyfjes

(Latin, *linea* = line; the linear leaves)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Gard. Bull. Sing. 57 (2005) 55. **Basionym:** *X. adenotus* Miq. var. *lineare* Meijden *op. cit.* (1982) 101, *op. cit.* (1988) 516. **Type:** *Sinangul SAN* 57294, Borneo, Sabah, Lahad Datu district, Bt. Silam (holotype K; isotype SAN).

Tree, to 7 m tall and 9 cm diameter. **Bark** smooth, brown or blackish. **Twigs** smooth, without nodal glands, greenish, glabrous. **Axillary buds** solitary, long-triangular, 1–2 mm long, acute, glabrous, sometimes enclosed by a low ridge of the twig. **Leaves** (thinly) coriaceous, glabrous, flat and grey-green or brown above, light brown and not papillose below; blades linear or lanceolate-linear, more or less parallel-sided, (9–)13–38 × (1.3–)2–5.5 cm, base narrowly rounded or short-cuneate, apex acute or (long) acuminate; midrib raised above; lateral veins 9–14 pairs, at *c.* 45° to the midrib, forming a weak irregular intramarginal vein; intercostal venation reticulate, distinct or indistinct above; glands several, less than 0.5 mm diameter, scattered; petioles (8–)10–12(–18) mm long, glabrous, without glands, coarsely transversely wrinkled. **Inflorescences** (sub)terminal, 6–12 cm long, branched, many-flowered, flowers solitary; axes angular or terete, *c.* 1.5 mm thick, sometimes thickened to 3 mm thick and then densely set with pedicel scars, sparsely minutely hairy. **Flowers:** pedicels *c.* 2 mm long, sparsely hairy; outer sepals *c.* 2 mm long, inner sepals *c.* 3.5 mm long, minutely appressed hairy, petals pinkish or red, subglabrous but keel hairy outside, upper petals pilose inside at base, longest petal *c.* 9 mm long; filaments free, somewhat widened above base, anthers *c.* 1 mm long; ovary densely hairy all

around, c. 1 mm long stipitate, style partly minutely hairy, *stigma slightly 2-lobed, ovules 4*. **Fruits** globose, 1.3–1.8 cm diameter, light brown, *sparsely hairy*, glabrescent; pericarp thin; fruiting pedicels c. 3 mm long, sparsely hairy. **Seed 1**.

Distribution. Endemic in Borneo and so far known only from Bt. Silam, Lahad Datu district, Sabah (e.g., *Repin et al. SP 6225, SAN 29652, SAN 57294, SAN 95535, SAN 144533* and *SAN A 4182*).

Ecology. Stunted forest on ultrabasic bedrock at 200–500 m altitude.

22. *Xanthophyllum longum* W.J.de Wilde & Duyfjes

(Latin, *longus* = long; the petioles)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Gard. Bull. Sing. 57 (2005) 55. **Type:** *Sigin et al. SAN 107165*, Borneo, Sabah, Sandakan district, Ulu Sg. Pinangah (holotype SAN; isotypes KEP, L, SAR).

Tree, to 5 m tall and 10 cm diameter. **Bark** pale greenish or blackish. **Sapwood** white. **Twigs** smooth, without nodal glands, minutely hairy. **Axillary buds** solitary or in cluster of 2, less than 1 mm long, minutely hairy. **Leaves** glabrous except for the minutely patently hairy midrib and petiole, flat above, not papillose below; blades (narrowly) oblong, 15–20 × 6–7 cm, base rounded to short-attenuate, apex acute-acuminate; midrib raised above; lateral veins 8–10 pairs, forming an intramarginal vein; intercostal venation reticulate; glands inconspicuous; petioles (20–)30–40 mm long, 1–2 mm thick, the basal portion of c. 15 mm brown, the rest slightly narrower and drying as green as the midrib, glabrous, smooth, without glands. **Inflorescences** about half as long as the leaves, subapical, branched, axes minutely patently hairy. **Flowers** (after anthesis) single; pedicels 1–2 mm long; perianth, stamens and pistil unknown; ovary globose, densely grey(-brown) patently hairy all around (hairs c. 0.5 mm long), style caducous, stigma slightly 2-lobed, ovules 4. **Fruits** globose, 1.5–1.7 cm diameter, brownish, hairy; pericarp thin; fruiting pedicels c. 4 mm long. **Seed 1**.

Distribution. Endemic in Borneo and confined to Sabah, where it is known from Kinabatangan and Tawau districts (e.g., *SAN 81178, SAN 95970, SAN 107165, SAN 107277* and *SAN 107314*).

Ecology. Lowland forest, along streams, on undulating land and hillsides.

Notes. *Brunig LI 48*, from E Sarawak (sterile) keys out to *Xanthophyllum longum*, but represents an undescribed species.

23. *Xanthophyllum macrophyllum* Baker

(Greek, *makros* = large, *phullon* = leaf; the large leaves)

(subgen. *Xanthophyllum*, sect. *Xanthophyllum*)

Bull. Misc. Inform. Kew (1896) 21; Merrill *op. cit.* (1921) 326; Masamune *op. cit.* 380; Anderson *op. cit.* (1980) 287; Meijden *op. cit.* (1982) 78; *op. cit.* (1988) 507; Coode *et al.* (eds.) *op. cit.* 256; Argent

et al. (eds.) *op. cit.* 510; Beaman & Anderson *op. cit.* 265. **Type:** *Creagh s.n.*, Borneo, Sabah (holotype K; isotype BM).

Shrub or tree, 3–25 m tall, 3–30 cm diameter. **Bark** pale brown, smooth. **Sapwood** white or pale yellow. **Twigs** smooth, without nodal glands, green, glabrous. **Axillary buds** 0.5–2 mm long. **Leaves** sometimes slightly bullate and greenish above, glabrous or minutely hairy on midrib, mostly brownish green and not papillose below; blades narrowly elliptical, (10–)14–28 × 4–10 cm, base attenuate, apex acute-acuminate; midrib prominent above, rarely slightly sunken; lateral veins 7–10 pairs, forming a nearly complete and rather prominent intramarginal vein; intercostal venation scalariform; glands mostly few, scattered, c. 0.5 mm diameter; petioles 10–18 mm long, glabrous, with (0–)2(–4) glands, longitudinally wrinkled. **Inflorescences** on the upper parts of twigs, shorter than the leaves, mostly branched; axes appressed brown velvety; bracts often opposite, with 2 small indistinct glands. **Flowers:** pedicels 2–12 mm long; sepals shortly appressed brown hairy outside, ribbed inside, outer sepals 5–6 mm long, inner sepals 6–7 mm long; petals yellow, or white and the upper ones with a yellow spot, drying (yellowish to) brown or blackish, the longest one 13–16 mm long, keel clawed, appressed velvety outside, at apex more or less densely hairy inside, other petals glabrous or hairy outside at apex; filaments free, anthers 0.5–0.8 mm long, short hairy; ovary sessile or short stipitate, creamish brown, often c. 8-ribbed when dry, the median ribs mostly prominent and hairy over 1/3–2/3 their length, the other ribs hairy in apical part only, stigma slightly 2-lobed, ovules 6–14. **Fruits** globose, c. 2 cm diameter, yellow-brown or blackish, faintly ribbed in apical part, glabrous or hairy on ribs only; fruiting pedicels 5–12 mm long. **Seed** 1.

Distribution. Endemic in Borneo (Sabah, Sarawak, Brunei and W Kalimantan). In Sabah common, recorded from Keningau, Kinabatangan, Lahad Datu, Penampang, Pensiangan, Ranau, Sandakan, Sipitang, Tawau and Tenom districts (e.g., *SAN 15427*, *SAN 28753*, *SAN 35891*, *SAN 66044*, *SAN 130878*, *SAN 132732* and *SAN 135348*). In Sarawak also common, known from Kapit, Kuching, Lawas, Lubok Antu, Lundu, Marudi, Miri, Mukah and Tatau districts (e.g., *S 21776*, *S 32812*, *S 36095*, *S 33999*, *S 46512* and *S 54738*). Also known in Brunei (e.g., *SAN 17503*). In W Kalimantan known by one doubtful collection from G. Benuang (*Wiriadinata et al. ITTO/BB 310*).

Ecology. Lowland mixed dipterocarp forest and lower montane mossy forest, often near streams or on hillsides, from sea level to 1750 m altitudes.

Notes. *Xanthophyllum macrophyllum* resembles the highly variable *X. flavescens* but the latter differs from the former in having petals that are not blackish on drying. It is also reminiscent of *X. havilandii* but the latter differs by its thickish and densely flowered inflorescences.

24. *Xanthophyllum montanum* Meijden

(Latin, *mons* = mountain; growing in the mountains)

(subgen. **Triadelphum**)

Leiden Bot. Ser. 7 (1982) 137, *op. cit.* (1988) 532; Beaman & Anderson *op. cit.* 265. **Type:** *Mikil SAN 46765*, Borneo, Sabah, Ranau district, Mt. Kinabalu, Sosopodon FR (holotype L; isotypes K, SAN, SAR).

Tree, 10–30 m tall, 12–30 cm diameter. **Bark** orange-yellowish green, smooth, thinly flaky. **Sapwood** yellowish. **Twigs** smooth, slender, glabrous, with distinct nodal glands. **Axillary buds** solitary, inconspicuous. **Leaves** glabrous, flat and brownish green above, not papillose below; blades oblong, (4–)6–9 × 1–2.5(–3.5) cm, base cuneate, apex gradually acuminate; midrib sunken above; lateral veins 6–9 pairs, forming a distinct intramarginal vein; intercostal venation reticulate; glands 2–8(–15), scattered in the middle and apical parts of leaf blade, mostly closely together, not near the margin, 0.3–0.6 mm diameter; petioles 3.5–5 mm long, glabrous, indistinctly transversely wrinkled, without glands. **Inflorescences** to 3 cm long, (3–)5–7-flowered, minutely hairy, unbranched; nodal glands usually distinct, round or elongate, 0.3–0.6 mm long. **Flowers:** pedicels c. 5 mm long, sparsely minutely woolly hairy; sepals minutely hairy inside, outer sepals c. 3 mm long, inner sepals 3.5–4.5 mm long; petals yellowish brown when dry, the longest one 6–6.5 mm long, keel inside minutely hairy near base, upper petals hairy inside; stamens triadelphous, filaments hairy in basal part, anthers 0.6 mm long, glabrous; ovary 0.5(–1) mm stipitate, glabrous, style glabrous or minutely hairy at base, ovules 8–12. **Fruits** globose, c. 1 cm diameter, yellowish to greenish brown, smooth, dull, glabrous; pericarp thin; fruiting pedicels 4–6 mm long. **Seed** 1.

Distribution. Sumatra (doubtful) and Borneo (Sabah). In Sabah, confined to Mt. Kinabalu, Ranau district (e.g. *RSNB* 4884, *SAN* 29232, *SAN* 46726 and *SAN* 46765).

Ecology. Lower montane forest on brownish soil, at 900–1600 m altitude.

25. *Xanthophyllum neglectum* Meijden

(Latin, *negligere* = neglected; for a long time overlooked)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Bot. J. Linn. Soc. 67 (1973) 119, *op. cit.* (1982) 86, *op. cit.* (1988) 509; Anderson *op. cit.* (1980) 287; Argent *et al.* (eds.) *op. cit.* 510. **Type:** *Singh* *SAN* 24222, Borneo, Sabah (holotype L; isotypes K, KEP, L, SAN, SAR, SING).

Tree, 4–20 m tall, 5–20 cm diameter. **Bark** greyish or greenish brown or dark green, smooth. **Sapwood** pale yellow or brown. **Twigs** slender, c. 1 mm diameter, smooth, without nodal glands, green, glabrous. **Axillary buds** solitary or in pairs, half-patent, glabrous, elliptical to ovate-oblong, 1.5–4(–6) mm long, acute, yellowish. **Leaves** membranous or chartaceous, dull, glabrous, flat and greyish green above, sometimes slightly waxy, not papillose below; blades (narrowly) elliptical, 5–12 × 2–5.5 cm, base cuneate, margin often undulate, apex acute-acuminate; midrib prominent above; lateral veins 3–5 pairs, forming a distinct intramarginal vein; intercostal venation reticulate; glands 2–8, not in basal part, 0.2(–0.4) mm diameter; petioles 4–7 mm long, glabrous or sparsely short-hairy in the upper groove, without glands, hardly wrinkled or finely transversely wrinkled. **Inflorescences** slender, shorter than the leaves, 1.5–8 cm long, with 3–10 flowers (occasionally 2 per node), unbranched; axes c. 0.5 mm diameter, pale brown, sparsely patent short-hairy. **Flowers:** pedicels 2–4 mm long; outer sepals 2.2–2.5 mm long, inner sepals 3–3.5 mm long; petals white or yellowish, drying pale brownish, the longest one 7–10 mm long, keel nearly glabrous or hairy outside, short hairy inside basally, other petals glabrous except for some hairs at the base and apex; filaments free or to 0.5 mm connate, filaments of abaxial 4 stamens basally thickened, anthers c. 0.4 mm long; ovary (half-)patently hairy all around, c. 0.5 mm stipitate, style subglabrous, caducous, stigma slightly 2-lobed, ovules 4. **Fruits**

globose, *c.* 1 cm diameter, dull greyish green, slightly wrinkled, hairy all around; pericarp soft; fruiting pedicels slender, 2–4 mm long, pale brown. **Seed** 1.

Vernacular names. Sabah—*demining* (Dusun), *kemuning* (Dusun).

Distribution. Endemic in Borneo (Sabah, Sarawak, Kalimantan). In Sabah, known from Keningau, Kinabatangan, Lahad Datu and Sandakan districts (e.g., *SAN 17812*, *SAN 23509*, *SAN 27865*, *SAN 35262*, *SAN 111821* and *SAN 144332*) and in Sarawak from Gunung Buri, Samarahan district (e.g., *S 36666*). Also occurring in Kalimantan (e.g., *Ambriansyah AA 2156*, *Church et al. 1926*, *Kostermans 12630* and *de Vogel 854*).

Ecology. Mixed dipterocarp forest and lower montane forest, often along rivers, on sandstone or black and brown soil, at altitudes to *c.* 600 m.

Uses. In Kalimantan, the tough wood is used for axe handles.

Notes. *Xanthophyllum neglectum* is similar to *X. tenue* and *X. subcoriaceum*. See notes under *X. subcoriaceum*.

26. *Xanthophyllum nigricans* Meijden

(Latin, *nigricare* = becoming blackish; referring to drying plant parts)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Bot. J. Linn. Soc. 67 (1973) 119, *op. cit.* (1982) 82, *op. cit.* (1988) 508; Anderson *op. cit.* (1980) 287; Coode *et al.* (eds.) *op. cit.* 256. **Type:** Singh & Nordin *SAN 48764* Borneo, Sabah, Tawau district, Baradaya FR (holotype KEP; isotypes K, SAN).

Tree, to 25 m tall and 20 cm diameter. **Bark** greyish or dark brown, smooth, rough or flaky. **Sapwood** whitish or yellowish, hard. **Twigs** finely longitudinally wrinkled, glabrous, without nodal glands. **Axillary buds** in cluster of 2 or 3 (or 4), 1.5–2.5 mm long, densely patently light-brown short-hairy. **Leaves** glabrous, flat and (dark) brown above, sometimes bluish (because of thin waxy layer), and not papillose (irrespective of very fine occasional papillation) below; blades elliptical to narrowly elliptical, 3.5–12 × 1.2–5.5 cm, base cuneate, apex acute-acuminate; midrib (slightly) prominent above; lateral veins 5–6(–7) pairs, forming a more or less distinct intramarginal vein; intercostal venation reticulate; glands scarce or inconspicuous, located on or near the midrib, *c.* 0.1 mm diameter, basal ones often larger; petioles 6–11(–14) mm long, glabrous, variously wrinkled, without glands. **Inflorescences** shorter than the leaves, unbranched, bearing more than 6 flowers; axes black, sparsely appressed hairy; flowers in clusters of 1–3. **Flowers:** pedicels 2–3 mm long, black when dry, nearly glabrous; sepals glabrous outside, patently hairy inside at base, outer sepals *c.* 1.8 mm long, inner sepals *c.* 2.5 mm long; petals white, drying dark (reddish), sparsely appressed hairy outside, ciliolate apically, the longest one *c.* 8 mm long; filaments free, anthers *c.* 0.3 mm long, hairy at base; ovary black, glabrous, style glabrous or basally sparsely appressed hairy, stigma slightly 2-lobed, ovules 4. **Fruits** globose, *c.* 1.4 cm diameter, dull, slightly wrinkled, brownish, glabrous; fruiting pedicels 2–4 mm long, *c.* 2 mm thick. **Seed** 1.

Distribution. Endemic in Borneo (Sabah and Sarawak). In Sabah known from Beaufort, Keningau, Kinabatangan, Lahad Datu, Labuk Sugut, Sandakan, Semporna and Tawau

districts (e.g., *SAN 16730*, *SAN 40914*, *SAN 43594*, *SAN 93581* and *SAN 95842*) and in Sarawak, known by one collection from Sg. Ebau, Bintulu district (*S 48871*).

Ecology. In ridge and hillside forest, on yellowish, brown or black soil, at altitudes to 600 m.

Notes. Meijden (*op. cit.* 1982, *op. cit.* 1988) described the lower leaf surface as papillose, but this character was not observed in the present study.

27. *Xanthophyllum nitidum* W.J.de Wilde & Duyfjes

(Latin, *nitidus* = shiny; referring to both leaf surfaces)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Gard. Bull. Sing. 57 (2005) 56. **Type:** *Dewol et al. SAN 108778*, Borneo, Sabah, Kinabatangan district, Bt. Tawai FR (holotype SAN; isotypes A, BO, K, KEP, L, SAR, SING).

Tree, 20–30 m tall and 20–35 cm diameter. **Twigs** smooth, without nodal glands, yellow, glabrous. **Bark** smooth, black; inner bark yellowish. **Sapwood** white. **Axillary buds** solitary, c. 1 mm long, minutely short-hairy. **Leaves** glabrous, flat and green-yellow shiny above, not papillose below; blades oblong-lanceolate, 7–11 × 2–4 cm, base cuneate, apex acute-acuminate; midrib flat above; lateral veins 4–5 pairs, intramarginal vein indistinct; intercostal venation finely reticulate on both surfaces, areoles all of about the same size, small, c. 0.5 mm diameter; glands inconspicuous; petioles 8–12 mm long, glabrous, transversely wrinkled, without glands. **Inflorescences** 5–10 cm long, branched, minutely light brown hairy. **Flowers** 2 together at base, other flowers solitary; pedicels 2–3 mm long, hairy; perianth, stamens and pistil not seen; developing ovary and immature fruit sessile, globose, 4–6 mm diameter, (not densely) hairy all around, light green, ovules 4. **Fruits** unknown.

Distribution. Endemic in Borneo (Sabah and Kalimantan). In Sabah, known from Kinabatangan and Sandakan districts (e.g., *SAN 46624*, *SAN 71499* and *SAN 108778*) and in Kalimantan from Kutai (e.g., *Ariffin & Abriansyah AA 968* and *Sidiyasa 1118*).

Ecology. Lowland forest on brown soil over ultrabasic rock, at 100–400 m altitude.

28. *Xanthophyllum obscurum* A.W.Benn.

(Latin, *obscurus* = dark; referring to dark drying colour of the dried flower and fruit)

(subgen. *Brunophyllum*)

In Hooker f., Fl. Br. Ind. 1 (1874) 211; King *op. cit.* 141; Ridley *op. cit.* (1922) 144; Ng *op. cit.* (1972) 361, *op. cit.* (1975) 89; Anderson *op. cit.* (1980) 287; Meijden *op. cit.* (1982) 145, *op. cit.* (1988) 536; Kessler & Sidiyasa *op. cit.* 194; Turner *op. cit.* 406; Coode *et al.* (eds.) *op. cit.* 256; Argent *et al.* (eds.) 510; Pendry *op. cit.* 534. **Type:** *Maingay 144* (= *Kew Distr. 3115*), Singapore (holotype K). **Synonyms:** *X. insigne* A.W.Benn. *in Hooker f. op. cit.* 211, King *op. cit.* 144; *X. scortechinii* King *op. cit.* 140, Ridley *op. cit.* (1922) 143, Ng *op. cit.* (1972) 363, Anderson *op. cit.* (1980) 288.

Tree, 15–35 m tall and 20–55 cm diameter. **Bark** pale, brown-grey, smooth. **Sapwood** white or yellowish. **Twigs** glabrous, often thickened on the nodes and with adventitious

buds; nodal glands usually distinct, circular or elongate, *c.* 0.5 mm diameter. **Axillary buds** solitary, to 0.5 mm long. **Leaves** glabrous, flat and dark brown or greyish red-brown above, not papillose below; blades ovate to elliptical, (4–)7.5–17 × (1.5–)3.5–9 cm, base cuneate, apex rounded to obtuse or sometimes short-acuminate; midrib prominent or flat above; lateral veins (3–)6–9 pairs, sometimes in upper part forming an intramarginal vein; intercostal venation coarsely reticulate; glands 2–16, usually located near or on the margin, (0.2–)0.5–0.7(–1) mm diameter; petioles 5–11(–15) mm long, glabrous, without glands, transversely wrinkled. **Inflorescences** sometimes also on the older nodes, shorter than the leaves, unbranched; axes black, glabrous to sparsely short woolly hairy. **Flowers** black when dry; pedicels 3–11 mm long; outer sepals 3–5.5 mm long, inner sepals 4–7.5 mm long; petals unequal, white or purple, the upper ones with a yellow or green spot, inside glabrous or woolly hairy above insertion of filaments and at apex, the longest one 14–19 mm long, keel boat-shaped, 9.5–16 mm long, lateral petals spatulate, longer than upper petals and keel, upper petals more or less linear, flat to slightly channelled, curved upwards; stamens 7.5–12 mm long, filaments connate for (0.1–)1–3 mm, glabrous, free parts woolly hairy at base, the hairs often intertwined, forming a filamental ‘tube’, glabrous upwards, anthers 0.7–1.7 mm long, glabrous to minutely hairy, free or coherent around the stigma; ovary black, glabrous, style glabrous, stigma peltate, ovules 8–18. **Fruits** globose, (4–)5–7(–14) cm diameter, dull brown or blackish; pericarp 0.5–2 cm thick, not wrinkled, glabrous; fruiting pedicels 5–10 mm long, 5–15 mm thick. **Seeds** 8–16, sticking together like a ball on drying.

Vernacular names. Sarawak—*langir* (Malay), *mangok* (Iban), *masa pinsang* (Iban), *ngilas* (Malay).

Distribution. S Thailand, Sumatra, Peninsular Malaysia, Singapore, Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah, common and found in almost all districts (e.g., *SAN 40554*, *SAN 56887*, *SAN 66027*, *SAN 110636* and *SAN 135910*). In Sarawak, recorded from Bintulu, Kuching, Lundu, Marudi, Miri, Serian and Song districts (e.g., *S 6391*, *S 17003*, *S 26991*, *S 38006* and *S 70902*). Also occurring in Brunei (e.g., *BRUN 17696* and *Coo de et al. 7870*) and Kalimantan (e.g., *van Balgooy 6085*, *Burley 2473*, *Kostermans 10160*, *Nooteboom 4409* and *Sidiyasa 2182*).

Ecology. Lowland mixed dipterocarp forest, on flat land and hillsides and in lower montane forest, at altitudes to 1800 m, on sandstone-derived, yellow clayey soil, brown soil, black soil or sandy loam soil. Occasionally also occurs in *kerangas* forest.

Uses. The fruit is reported as edible. In Kalimantan, the wood is used for making knife sheaths.

29. *Xanthophyllum ovatifolium* Chodat

(Latin, *ovatus* = ovate, *folium* = leaf; referring to the shape of the leaf)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Bull. Herb. Boiss. 4 (1896) 258; Merrill *op. cit.* (1921) 326; Masamune *op. cit.* 380; Anderson *op. cit.* (1980) 287; Meijden *op. cit.* (1982) 83; *op. cit.* (1988) 508. **Type:** *Haviland 2090*, Borneo, Sarawak, Kuching district (holotype K; isotypes BM, L, SAR, SING).

Tree. **Twigs** glabrous, slender, smooth, without nodal glands. **Axillary buds** in clusters of 2 (or 3), 1–1.8 mm long; glands present or not. **Leaves** glabrous, flat and rather dull, brownish to greenish above, dull and not papillose below; blades ovate-elliptical, $3.5\text{--}9.5 \times 1.4\text{--}6$ cm, base rounded or broadly cuneate, apex acute, mostly cuspidate; midrib above slightly prominent at base; lateral veins 3–4 pairs, not forming an intramarginal vein; intercostal venation finely reticulate; glands 8–20, usually located halfway between margin and midrib, 0.4–0.6 mm diameter, basal glands usually present; petioles 3–5(–6) mm long, glabrous, without glands, transversely wrinkled. **Inflorescences** shorter than the leaves, unbranched, 4–6-flowered; axes brownish, glabrous to sparsely appressed hairy. **Flowers:** pedicels 7–8 mm long; sepals glabrous outside, outer sepals c. 2.8×1.7 mm, inner sepals $3\text{--}3.5 \times 1.8\text{--}2$ mm; petals white, drying pale brownish, ciliate at apex and base, for the rest glabrous, the longest one 9–10 mm long; filaments free, anthers 0.3–0.4 mm long, glabrous; ovary glabrous, style sparsely appressed hairy basally, stigma slightly 2-lobed, ovules 4. **Fruits** unknown.

Distribution. Sumatra (doubtful) and Borneo (Sarawak). In Sarawak uncommon and known from Kuching and Lundu districts (e.g., Haviland 2090, Haviland 2087 and S 7433).

30. *Xanthophyllum pachycarpon* W.J.de Wilde & Duyfjes

(Greek, *pachus* = thick, *karpos* = fruit; referring to the thick-walled fruits)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Gard. Bull. Sing. 57 (2005) 58. **Type:** *Lai et al.* S 69651, Borneo, Sarawak, Lubok Antu district, Nanga Segara, Sg. Engkari (holotype SAR; isotypes K, KEP, L, MO, SAN).

Tree, 12–30 m tall and to 30 cm diameter. **Bark** greyish or darkish green, smooth or with large warty lenticels. **Sapwood** orange-yellow. **Twigs** slender, glabrous, smooth, yellowish, without nodal glands. **Axillary buds** solitary, long-triangular, 1–1.5 mm long, glabrous. **Leaves** glabrous, flat and green-brown or light brown above, not papillose below; blades oblong, $8\text{--}16 \times 2.5\text{--}6$ cm, base cuneate, apex acute-acuminate; midrib slightly raised on both sides; lateral veins 4–6 pairs, forming an irregular intramarginal vein; intercostal venation finely and sharply reticulate on both surfaces; glands inconspicuous; petioles 6–12 mm long, longitudinally and transversely wrinkled, glabrous, without glands. **Inflorescences** much shorter than the leaves, unbranched, 7–10-flowered (flower-scars); axes short-hairy, glabrescent. **Flowers** unknown. **Fruits** globose, 2–3 cm diameter, light brown, coarsely (brain-like) wrinkled on drying, glabrous; pericarp 5–10 mm thick, solid or spongy by irregularly sized, scattered hollows; fruiting pedicels 3–4 mm long. **Seed** 1.

Vernacular names. Sarawak—*mangok* (Iban), *sambubu* (Malay), *sabetong* (Kayan).

Distribution. Endemic in Borneo (Sabah, Sarawak and W Kalimantan). In Sabah, known from Keningau, Kinabatangan, Labuk Sugut, Ranau, Sandakan and Tenom districts (e.g., SAN 51297, SAN 52099, SAN 65263, SAN 78258 and SAN 97680) and in Sarawak from Belaga, Lubok Antu and Serian districts (e.g., S 3525, S 27397 and S 69651). In W Kalimantan, collected twice from Serawai area (*Church et al.* 1524 and *Church et al.* 5626).

Ecology. Mixed dipterocarp forest, on hillridges and hillsides, at altitudes to 650 m, occurs also in forest on brown soil over ultrabasic bedrock.

Notes. *Xanthophyllum pachycarpon* vegetatively resembles *X. nitidum* but the latter differs by its finer but sharper intercostal venation, branched inflorescences and hairy young fruits.

31. *Xanthophyllum parvifolium* Meijden

Fig. 8.

(Latin, *parvus* = small, *folium* = leaf; with small leaves)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Bot. J. Linn. Soc. 67 (1973) 119, *op. cit.* (1982) 88, *op. cit.* (1988) 510; Anderson *op. cit.* (1980) 287.

Type: *Ilias* S 5396, Borneo, Sarawak, Samarahan district, Sabal FR (holotype L; isotypes KEP, SAN, SAR, SING).

Tree, 10–25 m tall and 15–30 cm diameter. **Bark** (yellowish) greyish, smooth. **Twigs** smooth, without nodal glands, glabrous, slender, c. 0.5 mm diameter, forming short shoots bearing 2 or 3 leaves. **Axillary buds** in clusters of two, c. 1 mm long. **Leaves** glabrous, more or less discolorous, flat, shiny and yellowish or greenish brown above, (indistinctly) papillose, yellowish to reddish brown below; blades elliptical-oblong, 1.5–5(–6) × 0.5–2 cm, base rounded or cuneate, apex long-acuminate with rounded tip; midrib flat or slightly prominent above; lateral veins 1–3 pairs, indistinct, forming an indistinct intramarginal vein; intercostal venation indistinct, reticulate; glands numerous, scattered, c. 0.1 mm diameter; petioles 2–2.5 mm long, glabrous, transversely wrinkled, without glands. **Inflorescences** (sub)apical, to 3.5 cm long, glabrous, unbranched; axes c. 0.5 mm diameter, 1–3-flowered. **Flowers:** pedicels 6–11 mm long; sepals purplish, (sub)glabrous outside, outer sepals c. 2 mm long, inner sepals 3–3.5 mm long; petals pale orange, drying orange brown, sparsely hairy at base and at apex, for the rest glabrous, the longest one 10–11 mm long; filaments free, filaments widened and thickened above the base and there densely patently short-hairy, for the rest glabrous, anthers c. 0.4 mm long, with few short hairs at base; ovary c. 1 mm stipitate, appressed hairy, style sparsely appressed hairy in lower half, stigma slightly 2-lobed, ovules 4. **Fruits** short stipitate, globose, 1–1.2 cm diameter, dull, pale brown, sparsely appressed short-hairy; pericarp thin; fruiting pedicels slender, 7–11 mm long, glabrous. **Seed** 1.

Distribution. Endemic in Borneo (Sarawak and Brunei). In Sarawak known from Limbang, Lundu, Miri, Mukah and Samarahan districts (e.g., *S* 5396, *S* 38315, *S* 38418, *S* 43019, *S* 49968 and *S* 79021). In Brunei, represented by one collection (*Ashton* 3332) from Belait district.

Ecology. Mixed dipterocarp forest and *kerangas* forest, at 30–1200 m altitude.

Notes. *Xanthophyllum parvifolium* is close to *X. ovatifolium* but the latter differs from the former by its *non-papillose* lower leaf surface.

32. *Xanthophyllum pauciflorum* Meijden

(Latin, *paucis* = few, *flos* = flower; referring to the few-flowered inflorescence)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Bot. J. Linn. Soc. 67 (1973) 119, *op. cit.* (1982) 87, *op. cit.* (1988) 509. **Type:** *Sibat* S 21934, Borneo, Sarawak, Tatau district, Bt. Mersing (holotype L; isotypes K, KEP, P, SAN, SAR, SING).

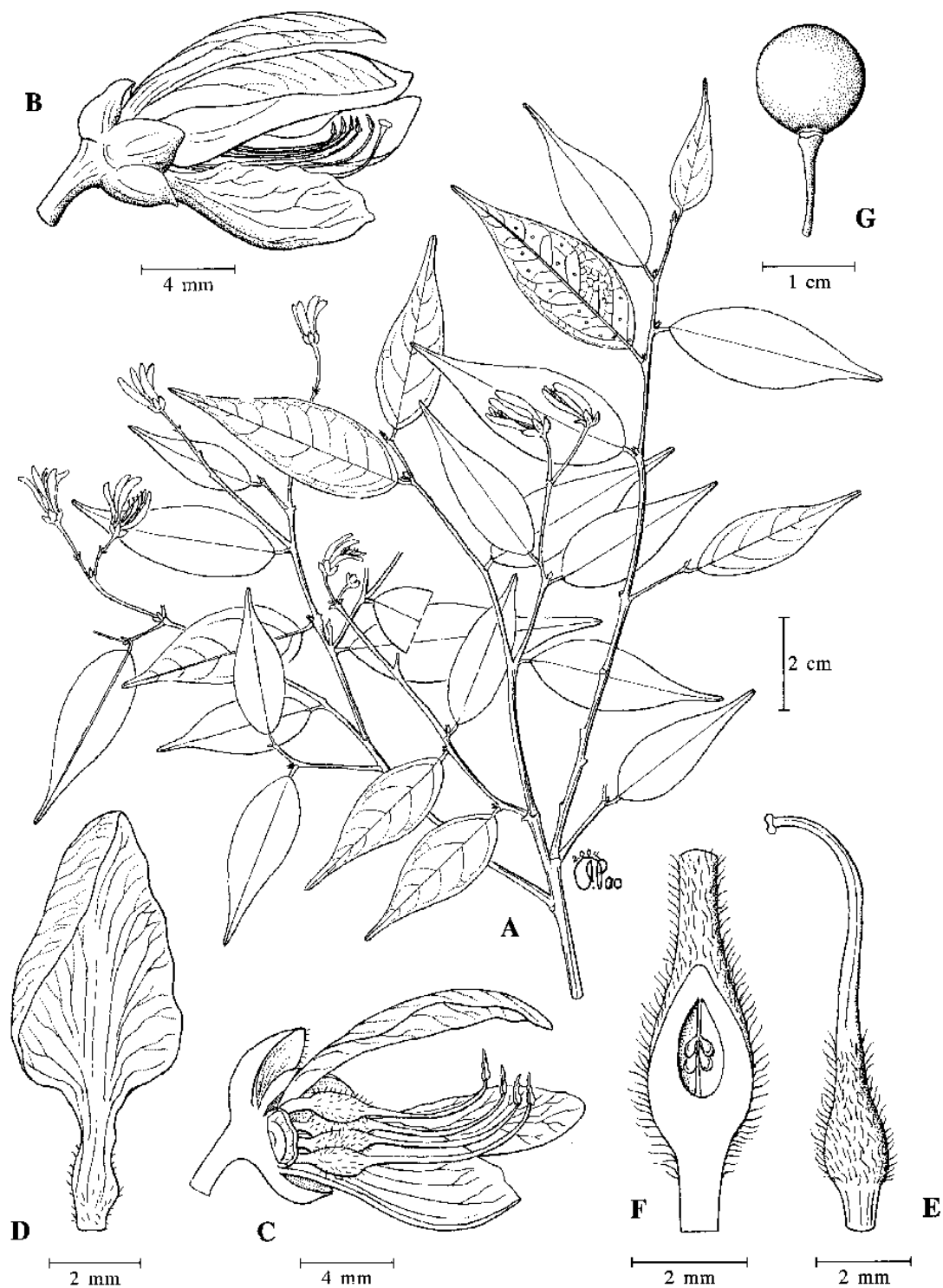


Fig. 8. *Xanthophyllum parvifolium*. A, flowering leafy twig; B, open flower; C, longitudinal section of open flower with the gynoeceum removed; D, lower petal; E, gynoeceum; F, longitudinal section of ovary; G, fruit. (A–F from *S* 43019, G from *S* 38315.)

Tree, 7–25 m tall and 7–25 cm diameter. **Bark** greyish, smooth. **Sapwood** brown. **Twigs** smooth, without nodal glands, glabrous, slender, more or less as thick as petioles, flush only a few internodes long. **Axillary buds** in pairs, small, 0.5–1.5 mm long. **Leaves** glabrous, flat and (dull) green above, papillose below; blades oblong to lanceolate, 5–8(–9) × 1.2–2.5(–3.5) cm, base acute, apex acuminate or cuspidate; midrib flat or raised above; lateral veins 4–6 pairs, not forming an intramarginal vein; intercostal venation reticulate; glands 2–7, minute, c. 0.2 mm diameter; petioles 3.5–4.5 mm long, transversely wrinkled, glabrous, without glands. **Inflorescences** much shorter than the leaves, 3–6-flowered, unbranched; axes slender, to 5 cm long, glabrous or sparsely patently short hairy. **Flowers:** pedicels 1.5–3 mm long, sepals with a small apical tuft, outer sepals c. 2 mm long, sparsely short-hairy outside, inner sepals c. 2.7 mm long, glabrous outside; petals yellowish, drying yellowish orange, sparsely hairy or glabrous outside, ciliate and apically tufted, at base densely hairy at both sides, the longest one 7.5–8.5 mm long; filaments free, anthers c. 0.4 mm long, with few hairs at base; ovary patently or appressed hairy, stigma slightly 2-lobed, ovules 4. **Fruits** globose, 1–1.7 cm diameter, olive-brown, smooth, with a distinct remnant of style, roughly hairy, glabrescent or glabrous; fruiting pedicels 2–5 mm long. **Seed** 1.

Distribution. Endemic in Borneo (Sarawak and Brunei). In Sarawak, known from Sri Aman and Tatau districts (e.g., *Chai ITTO/BC 109*, *S 21887*, *S 21934*, *S 21965* and *S 22387*). In Brunei, recorded from Tutong district (e.g., *BRUN 15558*).

Ecology. Mixed dipterocarp forest on basalt ridges or hillsides, at 250–800 m altitudes.

33. *Xanthophyllum pedicellatum* Meijden

(referring to the long pedicel)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Leiden Bot. Ser. 7 (1982) 113, *op. cit.* (1988) 522; Argent *et al.* (eds.) *op. cit.* 510. **Type:** Wood SAN 15009, Borneo, Sabah, Lahad Datu district, Bt. Silam (holotype L; isotypes BRI, KEP, SAN, SING).

Shrub, treelet or tree, 5–20 m tall, 5–20 cm diameter. **Bark** greyish or greenish, smooth. **Sapwood** pale yellow. **Twigs** 1–2 mm diameter, densely brownish patently long-hairy (hairs 0.5–1 mm long), glabrescent, without nodal glands. **Axillary buds** solitary, narrowly triangular, 1.5–3.5 mm long, hairy. **Leaves** discolorous, flat, dark green and shiny above, patently long-hairy (mainly on midrib) and papillose below; blades narrowly elliptical, 5–11 × 1.5–4 cm, base cuneate to rounded or slightly cordate, apex usually acutish; lateral veins 7–8 pairs, forming an indistinct intramarginal vein or not; intercostal venation reticulate; glands numerous, scattered, c. 0.1 mm diameter; petioles 1.5–3 mm long, patently long-hairy, smooth, without glands. **Inflorescences** as long as the leaves, unbranched; axes densely patently hairy, with hairs to 0.5 mm long. **Flowers:** pedicels 10–15 mm long; sepals sparsely minutely hairy outside, glabrous inside except at base; outer sepals 2–2.5 mm long, inner sepals 3–3.5 mm long; petals pinkish, drying orange-red, glabrous except for the ciliate base, the longest one 12.5 mm long; filaments (almost) free, anthers c. 1.5 mm long, sparsely minutely hairy at base; ovary subsessile, brownish half-patently hairy, style glabrous in apical part, stigma slightly 2-lobed, ovules 9–11. **Fruits** globose, c. 2 cm diameter, pale brownish, hairy; pericarp thin; fruiting pedicels 11–15 mm long. **Seed** 1.

Vernacular name. Sabah—*kandis dahan* (Kedayan).

Distribution. Endemic in Borneo (Sabah and Sarawak). In Sabah, known from Kinabatangan, Lahad Datu, Pensiangan and Sandakan districts (e.g., *SAN 37155*, *SAN 54141*, *SAN 62417*, *SAN 97398* and *SAN 131701*) and in Sarawak, recorded by one collection (*Zainudin et al. AZ 5705*) from Sg. Berangan, Belaga district.

Ecology. Lowland forest on hillslopes or ridges, also in swampy areas, at altitudes to 500 m, on brown or black soil, sandy soil, sandstone-derived soil and black soil over ultrabasic bedrock.

Notes. *Xanthophyllum pedicellatum* is closely related to *X. beccarianum* and possibly representing a delicate-branched ecotype of the latter. The differences between these two species as well as with other related species (e.g., *X. brachystachyum*, *X. purpureum*, *X. reticulatum* and *X. trichocladum*) need further study.

34. *Xanthophyllum penibukanense* Heine

Fig. 9.

(After the village Penibukan, Sabah)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Mitt. Bot. Staatssamml. München 6 (1953) 215, Pflz. Clemens Kinab. (1953) 50; Meijden *op. cit.* (1982) 110, *op. cit.* (1988) 521; Argent *et al.* (eds.) *op. cit.* 510; Beaman & Anderson *op. cit.* 265. **Lectotype** (Meijden, 1982): *Clemens 40794*, Borneo, Sabah, Ranau district, Mt. Kinabalu (M; isoelectotypes B, BM, G, K, L).

Shrub, treelet or tree, 3–12 m tall, 5–20 cm diameter. **Bark** grey(-green), smooth. **Sapwood** orange-yellow. **Twigs** smooth, without nodal glands, glabrous. **Axillary buds** solitary, ovate-oblong, 3–7 mm long, acute, flat but basally thickened, where often with exuberant cork-formation which may hide the scales completely, greyish to cream-coloured, more or less shiny. **Leaves** chartaceous, glabrous, discolorous, flat, dark green and shiny above, contrastingly paler and papillose below; blades ovate-(narrowly) elliptical, 7–18 × 2.5–7 cm, base long-attenuate, apex acute-acuminate; midrib slightly sunken or more or less prominent above; lateral veins and intercostal venation distinct; lateral veins 4–6 pairs, forming a distinct intramarginal vein in apical part, lowermost veins reaching to or over halfway up the blade; intercostal venation reticulate; glands numerous, scattered, 0.1–0.2 mm diameter; petioles 8–15 mm long, merging into the long-attenuate leaf base, blackish, glabrous, often transversely wrinkled, without glands. **Inflorescences** as long as or shorter than the leaves, unbranched; axes minutely sparsely appressed hairy or (sub)glabrous, on basal part flowers in clusters of up to 3. **Flowers:** pedicels 2–6 mm long, minutely appressed hairy; sepals sparsely hairy along the midrib or (sub)glabrous outside, often some with glandular spots, outer sepals c. 3 mm long, inner sepals 3–3.5 mm long; petals creamy white to pale purplish, the upper ones with a yellow spot, drying orange, glabrous outside, apically and basally ciliate, the longest one 11–13 mm long; filaments up to 2.5 mm connate, anthers c. 1.5 mm long, often minutely hairy all over; ovary 1–2 mm stipitate, densely hairy or partly glabrous, style thinly appressed hairy in basal part, stigma slightly 2-lobed, ovules 8–12. **Fruits** globose, c. 1.5 cm diameter, more or less shiny, brownish, glabrous or nearly so; pericarp thin; fruiting pedicels 4–10 mm long. **Seed** 1.

Vernacular names. Sarawak—*blutai* (Kenyah), *sigarangan* (Kelabit).

Distribution. Endemic in Borneo (Sabah, Sarawak, Brunei and E Kalimantan). In Sabah, known from Keningau, Kota Belud, Penampang and Ranau districts (e.g., *Kokawa 5369*, *RSNB 1264*, *SAN 53972*, *SAN 85444* and *SAN 113012*) and in Sarawak from Bau, Belaga, Bintulu, Kuching, Limbang, Marudi, Miri and Samarahan districts (e.g., *S 24001*, *S 29205*, *S 43614*, *S 55223*, *S 74388* and *S 80873*). In Brunei recorded by one collection (*Kessler 424*) from Belait district and in Kalimantan from Sekatak and Sanggau (e.g., *Murata et al. s.n.* and *de Jong 308*).

Ecology. Mixed dipterocarp forest and lower montane forest, at altitudes to 1500 m, near streams, on hills or ridges, on limestone rock or sandy (loam) soil. Occasionally also in *kerangas* forest.

Notes. A species with variable indumentum of the ovary.

Uses. In Sarawak, the wood is used for making knife handles.

35. *Xanthophyllum pseudoadenotus* Meijden

(Greek, *pseudein* = deceive; referring to the similarity to *X. adenotus*)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Leiden Bot. Ser. 7 (1982) 110, *p.p. (excl. syn.)*, *op. cit.* (1988) 521, *p.p. (excl. syn.)*. **Type:** *Haviland 2113*, Borneo, Sarawak (holotype K; isotypes SAR, SING).

Treelet or small tree, 3–12 m tall. **Twigs** smooth, grey-brown, early glabrescent, 2–4 mm diameter, without nodal glands. **Axillary buds** solitary, long-triangular, 4–6 mm long, grey-brown, glabrous. **Leaves** glabrous, discolorous, flat and dark green above, pale cinnamon yellowish and papillose below; blades narrowly (ovate-)elliptical, 18–35 × 5.5–10 cm, base attenuate, apex acute-acuminate; midrib pale, raised above; lateral veins 12–14 pairs, rather patent, lower pairs not reaching the middle of blade, forming a faint intramarginal vein; intercostal venation reticulate; glands numerous, minute, less than 0.1 mm diameter, scattered; petioles 10–15 mm long, glabrous, longitudinally or transversely wrinkled, without glands. **Inflorescences** 5–7 cm long, unbranched, with 10–15 flowers; axes subglabrous. **Flowers:** pedicels 5–6 mm long, minutely appressed hairy, hairs c. 0.1 mm long; sepals 2–3.2 mm long; petals subglabrous, brownish orange on drying, the longest one c. 15 mm long; filaments c. 1.5 mm connate, anthers c. 2 mm long, ciliate along slits; ovary with appressed hairs 0.1–0.2 mm long, style glabrous in apical part, stigma slightly 2-lobed, ovules 9–11. **Fruits** globose, c. 1.5 cm diameter, greenish or brown, minutely appressed hairy, glabrescent; pericarp thin, brittle; fruiting pedicels 5–7 mm long. **Seed** 1.

Distribution. Endemic in Borneo (Sarawak and Kalimantan). In Sarawak, known from Belaga, Kuching and Miri districts (e.g., *Chew CWL 1153*, *Haviland 2113*, *S 35295* and *S 45496*). In W Kalimantan, known from Ngira (e.g., *de Jong 851*).

Ecology. Forest on stream banks, on sandy loam soil, at c. 200 m altitude.

Notes. The present circumscription of the species is different from the original one, leaving out specimens now included in *X. bicolor*, a species with longer petioles and a much narrowed leaf base, and in *X. pulchrum*, a species with shorter petioles and a cordate or rounded leaf base. *Xanthophyllum pseudoadenotus* resembles *X. adenotus*, a species with

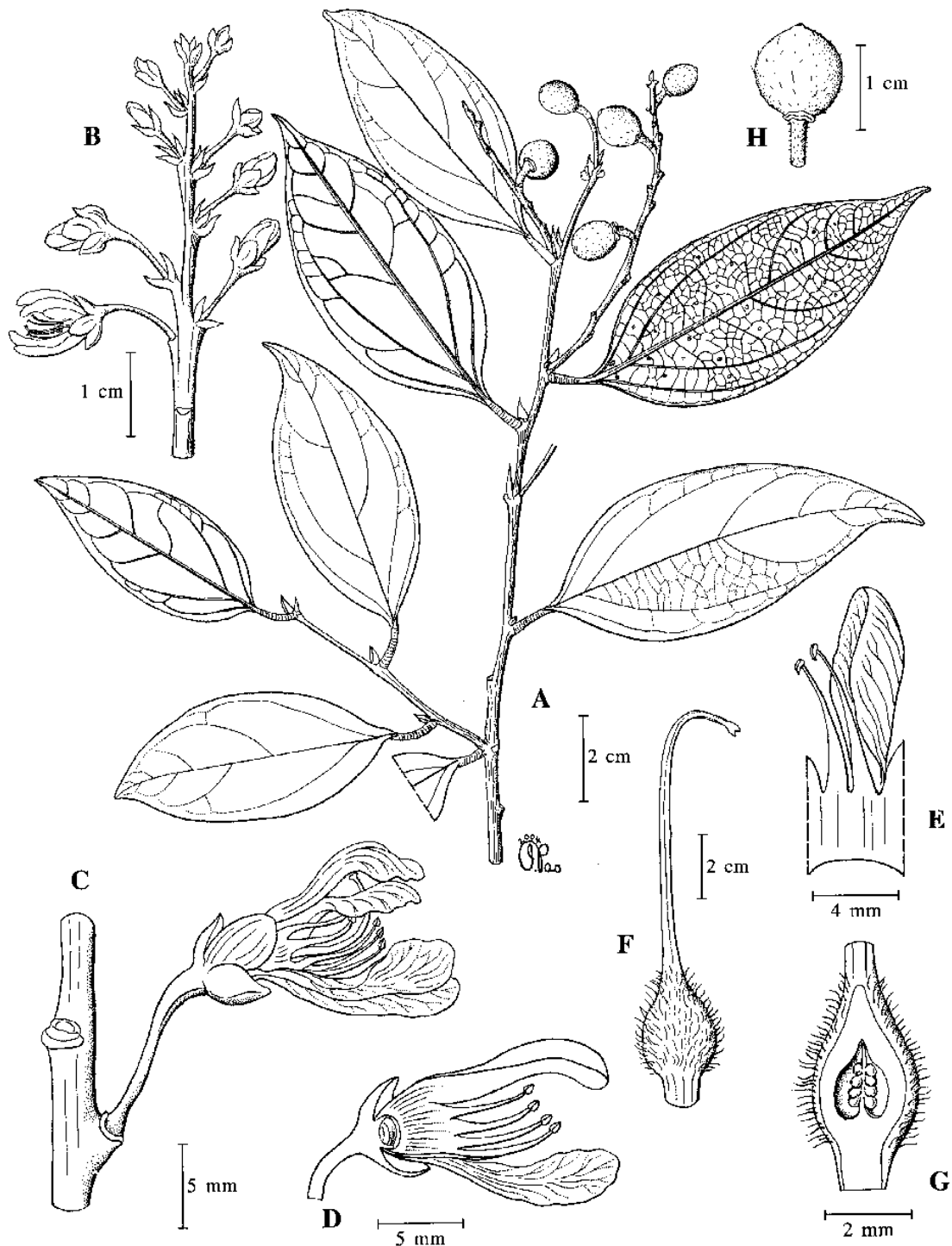


Fig. 9. *Xanthophyllum penibukanense*. A, fruiting leafy twig; B, inflorescence; C, open flower; D, longitudinal section of open flower with the gynoecium removed; E, adaxial view of petal and stamens; F, gynoecium; G, longitudinal section of ovary; H, fruit. (A from S 20112, B–G from S 36889, H from S 20112.)

branched inflorescences and a more or less concolourous, brown, *non-papillose* lower leaf surface.

36. *Xanthophyllum pulchrum* King

(Latin, *pulcher* = beautiful; referring to the tree)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

J. As. Soc. Beng. 59, 2 (1890) 141; Ridley *op. cit.* (1922) 146; Ng *op. cit.* (1972) 361; Anderson *op. cit.* (1980) 287; Meijden *op. cit.* (1982) 111, *op. cit.* (1988) 521; Turner *op. cit.* 406. **Lectotype** (Meijden, 1982): *King's Collector* 2859, Peninsular Malaysia, Perak (L; isolectotypes FI, G, K, L, P, Z). **Synonyms:** *X. densiflorum* Chodat, Bull. Herb. Boiss. 4 (1896) 256, Merrill *op. cit.* (1921) 325, Masamune *op. cit.* 379; *X. stapfii* Chodat, Bull. Herb. Boiss. 4 (1896) 260, *p.p.* (*excl. specim. Haviland 1620* [= *X. adenotus* Miq. var. *adenotus*]), Merrill *op. cit.* (1921) 326; Masamune *op. cit.* 381; *X. hypoleucum* Merr. *op. cit.* (1929) 135, Masamune *op. cit.* 380; *X. pulchrum* King subsp. *stapfii* (Chodat) Meijden *op. cit.* (1982) 112, *op. cit.* (1988) 522.

Shrub, treelet or small tree, 2–11(–30) m tall, 3–20(–30) cm diameter. **Bark** grey, brown or pale greenish, smooth, lenticellate. **Sapwood** white, yellowish orange or brown. **Twigs** smooth, glabrous or patently short-hairy, at apex 2–4 mm diameter, without nodal glands. **Axillary buds** solitary, half-patent, ovate or oblong, 2–6 mm long, thickened in lower half, obtuse or acute, pale brown or reddish, often irregular because of cork-forming, adventitious buds often present. **Leaves** chartaceous, glabrous, discolorous, sometimes bullate between lateral veins and green above, papillose below; blade narrowly (ovate-)elliptical, 7–30 × 2–11 cm, base rounded-cordate, obtuse, or short cuneate, apex acutish; midrib flat or (indistinctly) prominent above; lateral veins 5–14 pairs, forming mostly an (indistinct) intramarginal vein in apical half; intercostal venation reticulate; glands numerous, scattered, 0.1–0.2 mm diameter; petioles 4–8 mm long, longitudinally or transversely wrinkled, glabrous or appressed short-hairy all round, the older ones transversely cracked and more or less corky, without glands. **Inflorescences** shorter than the leaves, few to many-flowered, at the ends of young twigs but also axillary, not rarely on old nodes, unbranched; axes (sparsely) short-hairy, on its basal part flowers in clusters of up to 3; bracts with glands, subpersistent, lower ones (sub)opposite. **Flowers:** pedicels 2–8 mm long, glabrous or hairy; sepals often with glands, glabrous or hairy, outer sepals 2–5 mm long, inner sepals 3–6 mm long; petals pink or whitish, drying red or brownish orange, slightly hairy apically and basally inside, the longest one 11–18 mm long; filaments free or to 2 mm connate, anthers 2–2.5(–3.5) mm long, hairy at base or all over, ciliate along slits; ovary sessile or to 2 mm stipitate, whitish or pale brown hairy, style glabrous in apical part, stigma slightly 2-lobed, ovules 8–16. **Fruits** globose, 1–2 cm diameter, (sparsely) appressed hairy; pericarp thin, brittle, pale brown; fruiting pedicels 5–8 mm long. **Seed** 1.

Vernacular names. Sarawak—*menjalin* (Iban), *bait musang* (Iban), *penapan* (Iban).

Distribution. Peninsular Malaysia and Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah, recorded from Keningau, Kinabatangan, Labuk Sugut, Lahat Datu, Pensiangan, Pitas, Ranau, Sandakan and Tawau districts (e.g., *SAN* 21397, *SAN* 30359, *SAN* 44523, *SAN* 96510 and *SAN* 108737) and in Sarawak from Bau, Belaga, Kapit, Kuching, Lundu, Marudi and Tatau districts (e.g., *S* 21711, *S* 48606, *S* 69332 and *S* 79474). Also occurring in Brunei (e.g., *Flemmich FMS* 34415) and Kalimantan (e.g., *Kostermans* 4673 and *Shea ANU* 26377).

Ecology. Mixed dipterocarp forest near streams, on hillsides, hilltops, slopes or ridges, or in swampy areas, on sandy clay soil or on limestone, also on ultrabasic bedrock, at altitudes to 1000 m.

Notes. Pending a detailed (field) study, we have disregarded the ambiguous character of the mode of wrinkling of the petiole to distinguish *Xanthophyllum pulchrum* subsp. *stapfii*, *X. pseudoadenotus* and Bornean specimens of *X. discolor* (partly), as applied by Meijden (*op. cit.* 1982, *op. cit.* 1988). Instead, we accepted *X. pulchrum* as a variable species, characterized by the petiole length and the shape of the leaf base. The species also resembles *X. bicolor* and *X. penibukanense* in many respects, and the differences need further investigation. *Xanthophyllum discolor* is regarded as a distinct species differing from *X. pulchrum* in the number of ovules per ovary (4–8 in the former and 8–16 in the latter), thinner twigs (1–1.5 vs. 2–4 mm diameter), smaller leaves (5–14 × 1.5–5 vs. 7–30 × 2–11 cm), longer petioles (8–12 vs. 4–8 mm) and shorter longest petals (10–11 vs. 11–18 mm). Most Bornean specimens previously identified by Meijden (1982) as *X. discolor* subsp. *discolor* (e.g., SAN 21397, SAN 30359, SAN 32718, SAN 35564 and SAN 36059) belong to *X. pulchrum*.

37. *Xanthophyllum purpureum* Ridl.

Fig. 10.

(Latin, *purpureus* = purple; referring to the purple flowers)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Bull. Misc. Inform. Kew (1938) 114; Masamune *op. cit.* 381; Meijden *op. cit.* (1982) 114, *op. cit.* (1988) 522; Coode *et al.* (eds.) *op. cit.* 256; Beaman & Anderson *op. cit.* 266. **Type:** Moulton 174, Borneo, Sarawak (holotype K; isotype SING). **Synonym:** *X. molle* Ridl. *op. cit.* (1938) 114, Masamune *op. cit.* 380.

Shrub or small tree, 3–6 m tall, 2–20 cm diameter. **Bark** whitish or (dark) brown, smooth. **Sapwood** white, pale yellow or orange, hard. **Twigs** smooth, mostly densely dark rusty patently long-hairy, (1–)2–3 mm thick, without nodal glands. **Axillary buds** solitary, narrowly triangular, (1.5–)3–5 mm long, basally thickened. **Leaves** more or less densely patently long-hairy (hairs c. 0.5 mm long) all over or only on midrib and veins, more or less discolourous, flat and green above, papillose below; blades elliptical or narrowly elliptical, 8–20 × 2–9 cm, base cordate to rounded-attenuate, rarely cuneate, apex acutish; midrib slightly sunken to flat above; lateral veins (5–)6–7 pairs, not or only in apical part forming an intramarginal vein; intercostal venation reticulate; glands numerous, scattered, c. 0.1 mm diameter; petioles c. 5 mm long, smooth, densely patently long-hairy, without glands. **Inflorescences** shorter than the leaves, more than 1 cm long, unbranched; axes with sparse hairs to 0.2 mm long, few- to many-flowered, on its basal part the flowers often in clusters of 3. **Flowers:** pedicels 2–7 mm long; sepals minutely hairy outside (hairs 0.1 mm long), subglabrous inside, often with tiny, glandular spots, outer sepals 2–3 mm long, inner sepals 2.5–4 mm long; petals (light) purple to rose-violet, drying orange-red, ciliate at base and apex, for the rest glabrous, the longest one 11–12(–14) mm long; filaments free or 0.4 mm connate, anthers 1–1.5 mm long, glabrous or short hairy at base; ovary subsessile or c. 1.5 mm stipitate, patently hairy, style glabrous in apical half, stigma slightly 2-lobed, ovules 8–14. **Fruits** globose, 1–1.5 cm diameter, pale yellow-brown, hairy; pericarp thin; fruiting pedicels 3–7 mm long. **Seed** 1.

Distribution. Endemic in Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah common and recorded from most districts (e.g., *SAN 50479*, *SAN 72369*, *SAN 89392*, *SAN 92954* and *SAN 110469*). In Sarawak also common, known from Bintulu, Kapit, Kuching, Limbang, Marudi and Song districts (e.g., *S 26031*, *S 32237*, *S 40317*, *S 50302* and *S 65072*). Also occurring in Brunei (e.g., *Wong WKM 1235*) and in Kalimantan (e.g., *Church et al. 1586*, *Endert 3589*, *Nooteboom 4707* and *Peters 1033*).

Ecology. Mixed dipterocarp forest and lower montane forest, on hillsides, along ridges or streams, on yellow sandy loam soil, clay soil or on ultrabasic bedrock, at low altitudes to c. 1100 m. Occasionally occurs in *kerangas* forest.

Uses. In Kalimantan, the wood is used for general construction.

38. *Xanthophyllum ramiflorum* Meijden

Fig. 11.

(Latin *ramiflorus* = flowering on the older branches)

(subgen. **Coriaceum**)

Blumea 18 (1970), *op. cit.* (1982) 133, *op. cit.* (1988) 530; Anderson *op. cit.* (1980) 288; Coode *et al.* (eds.) *op. cit.* 256. **Type:** Anderson *S 16051*, Borneo, Sarawak, Kuching district, Bako NP (holotype L; isotypes SAR [not located], SING).

Shrub or tree, 5–30 m tall, to 40 cm diameter. **Bark** pale brown. **Twigs** smooth, nodes with a pair of annular glands, glabrous. **Axillary buds** in pairs, very indistinct when dormant, sunken into the tissue of the twig, the upper one when fully developed produces 2 broadly ovate 1–1.5 mm long persistent scales. **Leaves** coriaceous, glabrous, more or less discolorous, flat and brownish above, paler and papillose below; blades elliptical, 7–20 × 3–8 cm, base cuneate, apex blunt (obtuse to subacute); midrib slightly sunken to flat above; lateral veins c. 8 pairs, not forming an intramarginal vein; intercostal venation coarsely reticulate; glands numerous, scattered, c. 0.3 mm diameter; petioles (5–)8–12 mm long, glabrous, coarsely longitudinally and finely transversely wrinkled, without glands. **Inflorescences** solitary or up to 9 together in the axils of the lower leaves or lower down on the older twigs, unbranched, 1–10-flowered; axes to 1.5 cm long, thin, glabrous; nodal glands indistinct; bracts small, scale-like. **Flowers:** pedicels 8–10 mm long; sepals dark (reddish) when dry, glabrous except for ciliate margin, outer sepals c. 4 mm long, inner sepals 4.5–5 mm long; petals white, the upper ones with a purple mark, drying yellowish, minutely hairy in basal half on both sides, keel like the lateral petals but shorter, lateral petals 7.5–8.5 × 7 mm, upper petals up to 7 × 2 mm; stamens 8, exceptionally 7, monadelphous, filaments c. 5 mm long, 1.5–2 mm connate, densely short-hairy to about halfway, anthers 0.7–0.8 mm long, minutely ciliate and short hairy at base; ovary pale brownish, glabrous, style c. 5 mm long, glabrous, stigma peltate, oblique, ovules 8–12. **Fruits** 1–4 on the branches, glabrous, more or less globose, c. 1.2 cm diameter, pustulate, dull, reddish brown, the style-scar more or less protruding and excentric; fruiting pedicels c. 15 mm long. **Seeds** 1 or 2.

Vernacular name. Sarawak—*nyalin padang* (preferred name).

Distribution. Endemic in Borneo (Sarawak, Brunei and Kalimantan). In Sarawak, known from Julau, Kuching, Sibuan and Simunjan districts (e.g., *S 2614*, *S 12894*, *S 16051*, *S 27802*

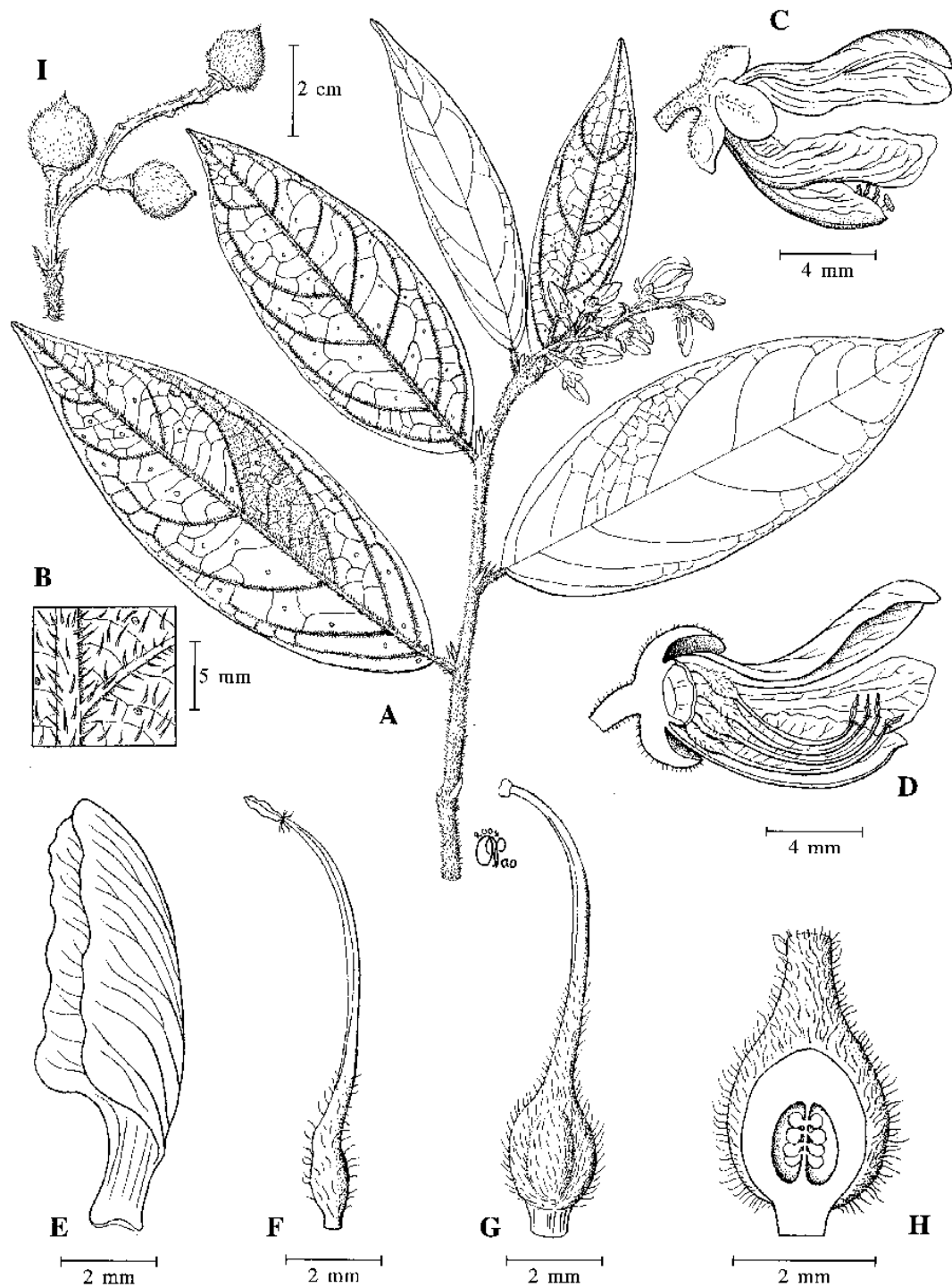


Fig. 10. *Xanthophyllum purpureum*. A, flowering leafy twig; B, detail of lower leaf surface with indumentum; C, open flower; D, longitudinal section of open flower with the gynoecium removed; E, lower petal; F, stamen; G, gynocium; H, longitudinal section of ovary; I, infructescence. (A–H from SAN 139519, I from SAN 86027.)

and S 30529). In Brunei, recorded from Belait district (e.g., *BRUN* 977 and S 2830) and in W Kalimantan from Danau Santarum Wildlife Sanctuary (e.g., *Zulkarnain et al.* 475).

Ecology. Confined to peatswamp forest and *kerangas* forest on poor, sandy, wet soil.

39. *Xanthophyllum rectum* W.J.de Wilde & Duyfjes

(Latin, *rectus* = upright; referring to the inflorescences)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Gard. Bull. Sing. 57 (2005) 59. **Type:** *Ilias* S 17903, Borneo, Sarawak, Kuching district, Bako National Park (holotype SAR; isotypes A, BO, K, KEP, L, MEL, SAR, SING).

Tree, 5–12 m tall, to 20 cm diameter. **Bark** pale grey, smooth or finely fissured; inner bark yellow-brown. **Twigs** black, smooth, glabrous, c. 5 mm thick, without nodal glands. **Axillary buds**, solitary, less than 0.5 mm long, subglabrous. **Leaves** coriaceous, glabrous, flat and dark grey(-green) brown above, chocolate-brown and not papillose below; blades elliptical-oblong, 7–13 × 3–7.5 cm, base rounded or short-cuneate, apex acute-acuminate (tip bluntish); midrib flat or slightly raised above; lateral veins 4–7 pairs, not forming an intramarginal vein; intercostal venation reticulate, raised and distinct below; glands absent or inconspicuous; petioles 7–12 mm long, glabrous, transversely wrinkled, without glands. **Inflorescences** stout, straight, erect, unbranched, 15–20-flowered; axes 8–13 cm long, 2–8 mm thick, sparsely minutely appressed brown-hairy. **Flowers** solitary, pale purple, drying blackish; pedicels c. 1 mm long; sepals c. 4 mm long, densely brown-hairy outside, somewhat hairy inside; petals c. 8 mm long, keel densely appressed brown-hairy outside, other petals tufted brown-hairy at base, for the rest glabrous; filaments free, c. 5 mm long, widened and patently brown-hairy above base, for the rest glabrous; pistil c. 3 mm long; anthers and mature stigma not seen; ovary sessile, patently (densely) hairy all around, stigma slightly 2-lobed, ovules 4. **Fruits** globose, c. 1.8 cm diameter, smooth, more or less shiny, dark-brown, more or less sparingly hairy all around, glabrescent; pericarp thin; fruiting pedicels c. 2.5 mm long, 3–4 mm thick. **Seed** 1.

Distribution. Endemic in Borneo and confined to Sarawak, where it is known from Bako NP and Sampadi FR in Kuching district (e.g., S 4446, S 17903, S 65493 and S 66789).

Ecology. Lowland *kerangas* forest, ridge dipterocarp forest, and rocky *padang* forest.

40. *Xanthophyllum reflexum* Meijden

(Latin, *reflectere* = bend backwards; referring to reflexed petals)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Leiden Bot. Ser. 7 (1982) 104, *op. cit.* (1988) 519; Beaman & Anderson *op. cit.* 266. **Type:** *Othman* S 32576, Borneo, Sarawak, Kuching district, Semengoh FR (holotype L; isotypes SAN, SAR, SING).

Tree, to 16 m tall, to 20 cm diameter. **Bark** whitish brown or pale greenish yellow, smooth, older trunk regularly set with pustulate lenticels 4–7 mm diameter. **Twigs** minutely patently short-hairy, lengthwise faintly grooved, without nodal glands. **Axillary buds** solitary, erect, appressed against twig, scales laterally flattened, triangular, 3–4.5 mm long, minutely

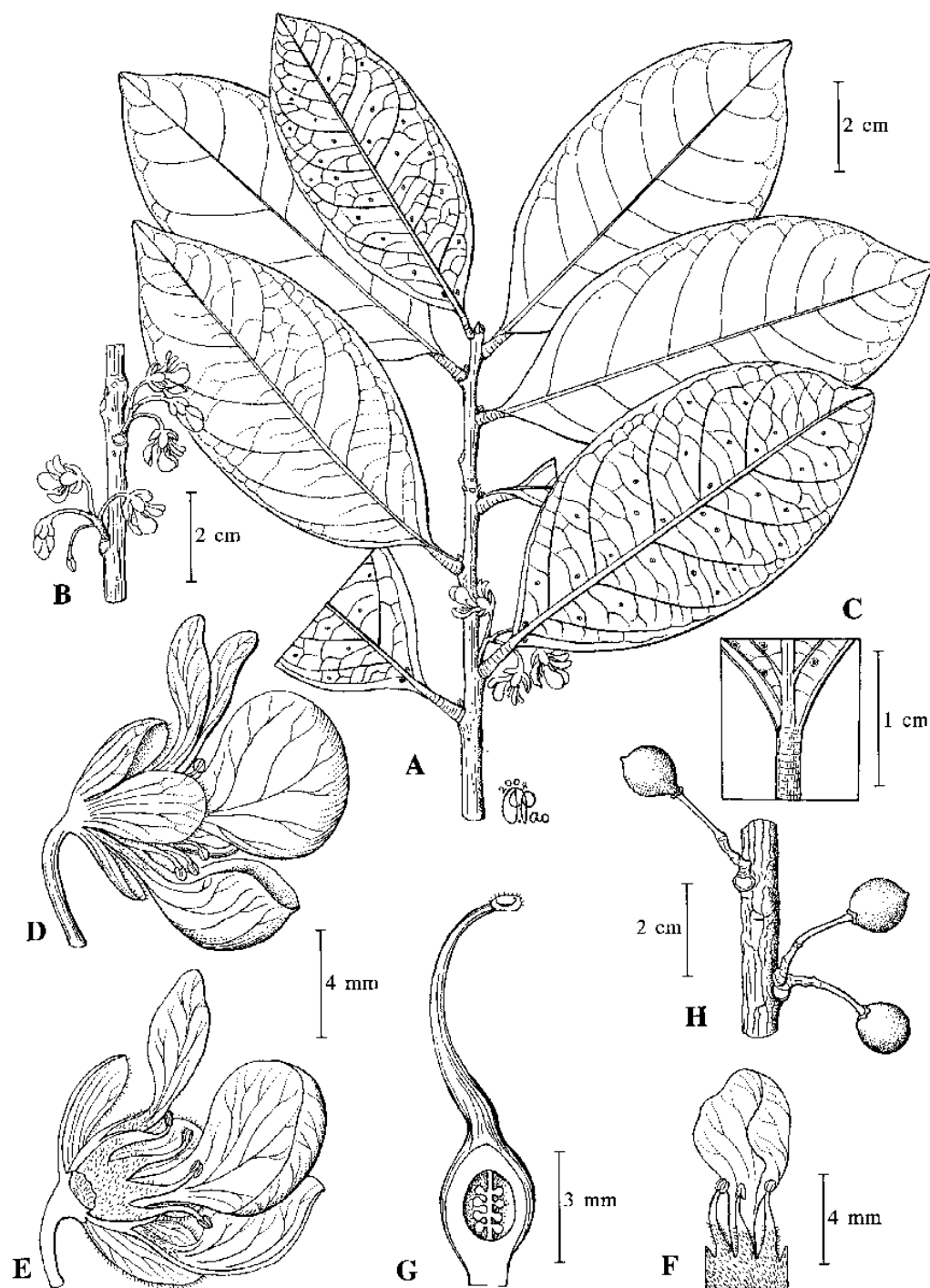


Fig. 11. *Xanthophyllum ramiflorum*. A, flowering leafy twig; B, twig with infructescences; C, detail of lower leaf base with glands; D, open flower; E, longitudinal section of open flower with the gynoeceum removed; F, adaxial view of lower petal and 3 stamens; G, gynoeceum with longitudinal section of ovary; H, twig with infructescences. (A–G from *S* 16051, H from *S* 12894.)

patently hairy. **Leaves** (sub)coriaceous, *glabrous, flat* and dull, greenish or yellowish brown above, *not papillose below*; blades narrowly (obovate-)elliptical, 11–18 × 3.5–5.5 cm; midrib more or less sunken above; lateral veins 6–9 pairs, indistinct, *in apical part forming an indistinct intramarginal vein*; intercostal venation obscure, *reticulate*; glands 2 (or 3), located near the leaf base, 0.4–0.7 mm diameter; petioles 9–10 mm long, somewhat wrinkled, densely minutely short-hairy, without glands. **Inflorescences** shorter or longer than the leaves, branched; axes dark, densely patently hairy; lower bracts opposite. **Flowers**: pedicels 2.5–3 mm long; outer sepals 2–2.5 mm long, inner sepals c. 4 mm long; petals unequal in length, yellowish white, drying dark red, the longest one 13–14 mm long, keel densely more or less appressed hairy outside, other petals glabrous, reflexed; *filaments free*, widened above base and with a knob-like short hairy appendage at inner side, for the rest glabrous, anthers 0.7–0.8 mm long, hairy or nearly glabrous at base; ovary subsessile, *half-patently hairy all around*, style pilose, stigma slightly hairy, ovules 4. **Fruits** unknown.

Distribution. Endemic in Borneo and confined to Sarawak where the species is known by two collections from Semengoh FR (S 32576 and S 91158).

Ecology. Lowland mixed dipterocarp forest.

41. **Xanthophyllum resupinatum** Meijden

(Latin, *resupinare* = reversed; referring to the leaves looking as if they were turned upside-down)

(subgen. **Xanthophyllum**, sect. **Xanthophyllum**)

Bot. J. Linn. Soc. 67 (1973) 120, *op. cit.* (1982) 74, *op. cit.* (1988) 504; Coode *et al.* (eds.) *op. cit.* 256; Argent *et al.* (eds.) *op. cit.* 511. **Type**: Chai SAN 29838, Borneo, Sabah, Tawau district, Kalumpang (holotype L; isotypes K, SAN, SAR, SING).

Tree, 5–25 m tall, 10–40 cm diameter. **Bark** grey or (dark) brown, smooth or flaking. **Sapwood** white or orange. **Twigs** smooth, glabrous, without nodal glands. **Axillary buds** solitary, inconspicuous, less than 0.5 mm long, more or less enclosed between basal part of the petiole and the twig. **Leaves** glabrous, flat, shiny and greenish above, yellowish brown to greenish brown, shiny and not papillose below; blades elliptical (oblong), 6–12.5 × 2.7–5 cm, base attenuate into a narrow petiole-like part, apex acute-acuminate; midrib conspicuously prominent above, flat, sunken or faintly prominent below; lateral veins 4–7 pairs, forming an incomplete, indistinct intramarginal vein; intercostal venation scalariform, indistinct; glands few, mostly located above the middle of the leaf, 0.3–0.7 mm diameter; petioles 4.5–7 mm long, appearing longer because of the narrow leaf base, transversely wrinkled, without glands. **Inflorescences** borne on the upper parts of twigs, shorter than the leaves, (un)branched; axes appressed greyish hairy. **Flowers**: pedicels 4–5 mm long; sepals dark brown to blackish when dry, with scattered minute glandular dots, outer ones c. 3 mm long, sometimes with 2 protruding glands halfway, inner sepals 4–5 mm long, slightly keeled; petals white, drying dark brownish, the longest one 7–9 mm long, keel densely half-patently greyish hairy outside, more or less hairy inside near apex, other petals glabrous; *filaments free*, anthers 0.5–0.7 mm long, faintly hairy; ovary dark brownish, ribbed, glabrous or appressed hairy on the ribs in apical part, stigma slightly 2-lobed, ovules 9–14. **Fruits** globose, c. 1.2 cm diameter, blackish, shiny, smooth or finely pustulate; pericarp rather thin, hard; fruiting pedicels 4–5 mm long. **Seed** 1.

Vernacular name. Sarawak—*mangok* (Iban).

Distribution. Endemic in Borneo (Sabah, Sarawak, Brunei and N & E Kalimantan). In Sabah, recorded from Sandakan, Semporna and Tawau districts (e.g., *SAN* 29606, *SAN* 30405, *SAN* 46327, *SAN* 48298 and *SAN* 57381) and in Sarawak from Belaga and Kapit districts (e.g., *S* 3574, *S* 3582, *S* 33144 and *S* 41659). Also occurring in Brunei (e.g., *BRUN* 624, *Dransfield et al.* 6636 and *Kirkup* 313) and Kalimantan (e.g., *Burley et al.* 872, *Church et al.* 1311 and *Sidiyasa PBU* 216).

Ecology. Mixed dipterocarp forest on flat land, hillsides or sandy ridges, at altitudes to 600 m.

Notes. *Xanthophyllum resupinatum* resembles *X. subcoriaceum* but the latter differs from the former by its reticulate intercostal venation.

42. *Xanthophyllum reticulatum* Chodat

(Latin, *reticulatus* = netted; referring to the leaf intercostal venation)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

In Merrill, PEB (1929) 136; Masamune *op. cit.* 381; Meijden *op. cit.* (1982) 114, *op. cit.* (1988) 523; Coode *et al.* (eds.) *op. cit.* 257. **Lectotype** (Meijden, 1982); *Elmer* 21119, Borneo, Sabah, Tawau (L; isolectotypes BM, BO, BR, BRI, C, G, K, M, P, SING).

Shrub, treelet or small tree, 2–15 m tall. **Bark** whitish. **Sapwood** yellowish or light greenish. **Twigs** smooth, with dense patent brown hairs up to 1 mm long, without nodal glands. **Axillary buds** solitary, half-patent, narrowly triangular, 4–6(–7.5) mm long, hairy. **Leaves** discolorous, bullate, glabrous and green above, green, not or indistinctly papillose and patently long-hairy (hairs 0.5 mm or longer) on midrib and on basal part of veins below; blades narrowly (ovate-)elliptical, 7–19 × 3–6.5 cm, base obtuse to rounded, rarely cuneate, apex acutish; midrib, lateral veins and part of finer intercostal venation sunken above; lateral veins c. 8 pairs (difficult to count), forming a distinct intramarginal vein; intercostal venation reticulate, not strongly prominent; glands numerous, scattered, c. 0.1 mm diameter; petioles c. 5 mm long, smooth, densely patently long-hairy, without glands. **Inflorescences** much shorter than the leaves, unbranched, 3–7 cm long, 5–15-flowered; axes with hairs c. 0.3 mm long; bracts c. 2 mm long. **Flowers:** pedicels 4–10 mm long, finely hairy; sepals sparsely hairy, ciliate on margin, outer sepals c. 2.5 mm long, inner sepals c. 3.5 mm long; petals purple, drying pale pink-brown, subglabrous, the longest c. 12 mm long; filaments almost free, glabrous, anthers 1(–1.5) mm long, glabrous; ovary c. 1 mm stipitate, densely hairy, style sparsely bristly hairy, stigma slightly 2-lobed, ovules 12–14. **Fruits** globose, c. 1.5 cm diameter, with remnant of style, hairy; fruiting pedicels 5–11 mm long, with patent hairs up to 0.2 mm long. **Seed** 1.

Distribution. Endemic in Borneo (Sabah and Brunei). In Sabah, recorded from Kinabatangan, Lahad Datu, Pensiangan, Sandakan and Tawau districts (e.g., *Pereira et al.* *JTP* 760, *SAN* 83572, *SAN* 95618, *SAN* 129473 and *SAN* 135319) and in Brunei from Belait and Tutong districts (e.g., *Forman* 984 and *Sands et al.* 5743).

Ecology. Mixed dipterocarp forest, along streams, on swampy places or hillridges, at altitudes to 400 m.

43. **Xanthophyllum rufum** A.W.Benn.

Fig. 12.

(Latin, *rufus* = reddish; referring to the reddish hairs)

(subgen. **Xanthophyllum**, sect. **Xanthophyllum**)

In Hooker f., Fl. Br. Ind. 1 (1874) 210; King *op. cit.* 143; Ridley *op. cit.* (1922) 145; Ng *op. cit.* (1972) 361; Anderson *op. cit.* (1980) 288; Meijden *op. cit.* (1982) 76, *op. cit.* (1988) 505; Turner *op. cit.* 406; Coode *et al.* (eds.) *op. cit.* 256; Argent *et al.* (eds.) *op. cit.* 511. **Type:** Maingay 139 (= Kew Distr. 1616), Peninsular Malaysia, Malacca (holotype K; isotype K). **Synonyms:** *X. flavum* Ridl. *op. cit.* (1922) 145; *X. heteropleurum* Chodat *op. cit.* (1929) 134, Masamune *op. cit.* 380, Ng *op. cit.* (1972) 363.

Tree, treelet, rarely shrub, to 40 m tall, to 50 cm diameter. **Bark** greenish grey or brown, smooth, pustulate or scaly, lenticellate. **Sapwood** (white) to yellow. **Twigs** smooth, without nodal glands, rufous-hairy. **Axillary buds** solitary, 1–2 mm long or smaller, densely patently long-hairy. **Leaves** more or less discolourous, glabrous, flat and bright yellow-green to pale greyish green above, paler, papillose and densely patently long-hairy (hairs c. 1 mm long) below; blades elliptical-oblong, 8–25 × 4–13 cm, base cuneate or rounded, sometimes subcordate, apex acute-acuminate; midrib and lateral veins slightly sunken above; lateral veins 5–9 pairs, forming an intramarginal vein; intercostal venation scalariform; glands numerous, scattered, c. 0.1 mm diameter, basal glands larger; petioles 7–21 mm long, densely patently long-hairy, sometimes glabrescent, smooth, apically often with large glands. **Inflorescences** shorter than or as long as the leaves, branched or sometimes unbranched; axes densely rufous-hairy; bracts conspicuous, persistent, often with glands, bracteoles small, subpersistent. **Flowers:** pedicels 4–7(–10) mm long; sepals densely rufous-hairy outside, glands inconspicuous or absent, outer sepals 4–6 mm long, slightly ribbed, inner sepals 5–7 mm long, keeled; petals white, the upper ones with a yellow spot, drying yellowish, the longest one 12–15 mm long, keel densely yellowish brown hairy outside, inside hairy in apical part, other petals hairy outside in apical part or only apically tufted; filaments free, widened and densely hairy in lower half, anthers 0.4–0.6 mm long, short-hairy at base or glabrous; ovary densely rufous-hairy all round or hairy in 4(–8) rows, hairs of the median rows mostly longer than the lateral ones, style densely rufous-hairy almost to apex, stigma slightly 2-lobed, ovules 12–14. **Fruits** globose, 1.5–2 cm diameter, subglabrous or with 2–4 sometimes hairy ridges from the style scar, yellowish green, dull, finely tuberculate; pericarp rather thick, hard; sometimes sepals persistent; fruiting pedicels 7–10 mm long, 2(–3) mm thick. **Seed** 1.

Distribution. Sumatra, Peninsular Malaysia, Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah, recorded from Keningau, Kinabatangan, Lahad Datu, Pensiangan, Sandakan, Sipitang, Tambunan, Tawau and Tenom districts (e.g., SAN 28690, SAN 44227, SAN 56990, SAN 77539 and SAN 119489) and in Sarawak from Belaga, Betong, Bintulu, Kapit, Kuching and Lundu districts (e.g., S 14805, S 24638, S 37998, S 46667 and S 55664). In Brunei, known by one collection from Belait district (i.e., Flemmich FMS 37109) and in Kalimantan from several localities in the western and eastern parts (e.g., bb. 18840, Burley *et al.* 744, de Jong 872 and Kostermans 5773).

Ecology. Mixed dipterocarp forest or riverine forest, on ridges or hilltops, on sandy (clay) soil, at altitudes to 300 m.

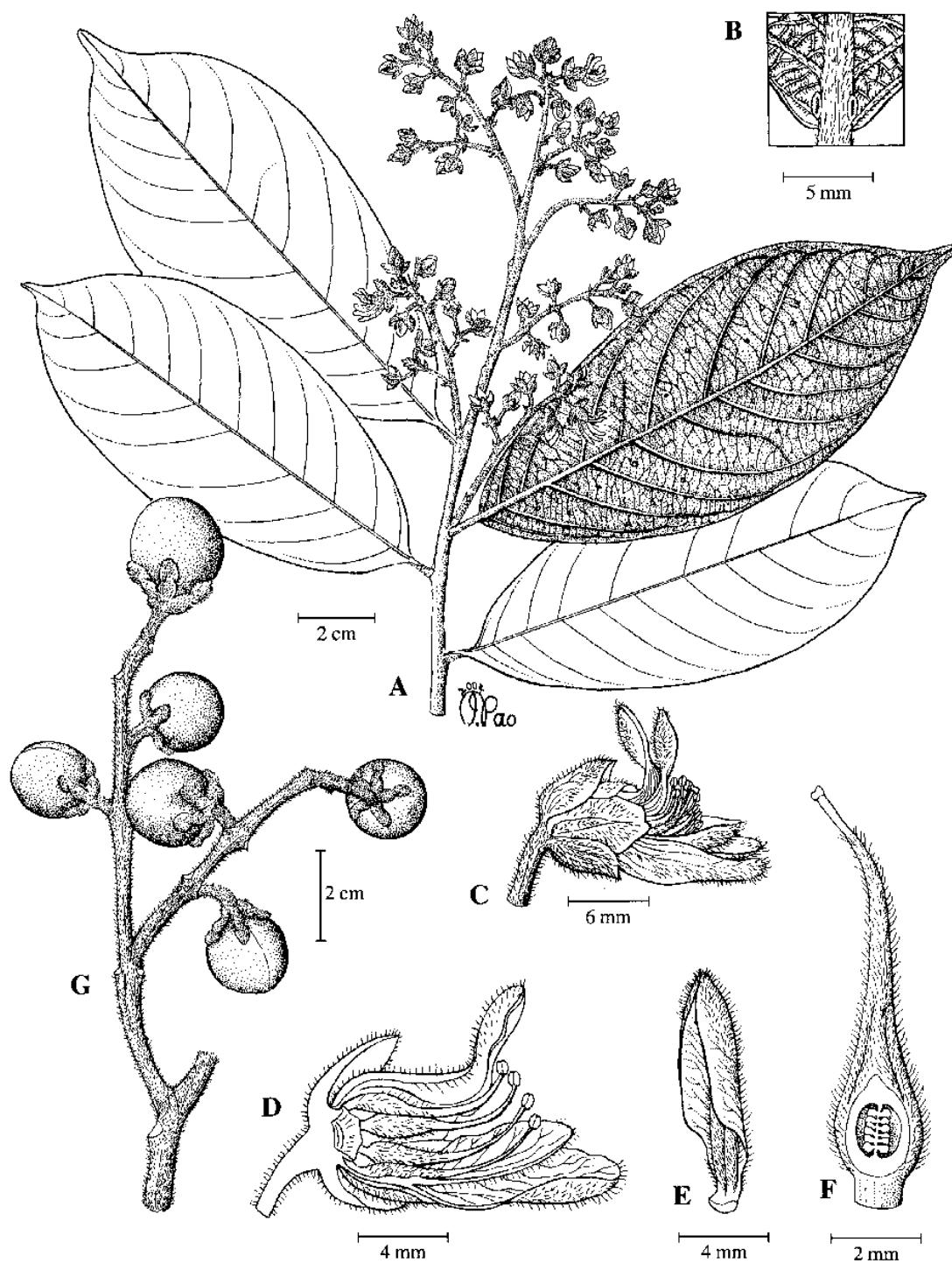


Fig. 12. *Xanthophyllum rufum*. A, flowering leafy twig; B, detail of lower leaf surface with indumentum and glands; C, open flower; D, longitudinal section of open flower with the gynoeceum removed; E, lower petal with 2 stamens; F, gynoeceum with longitudinal section of ovary; G, infructescence. (A–F from SAN 36554, G from S 17002.)

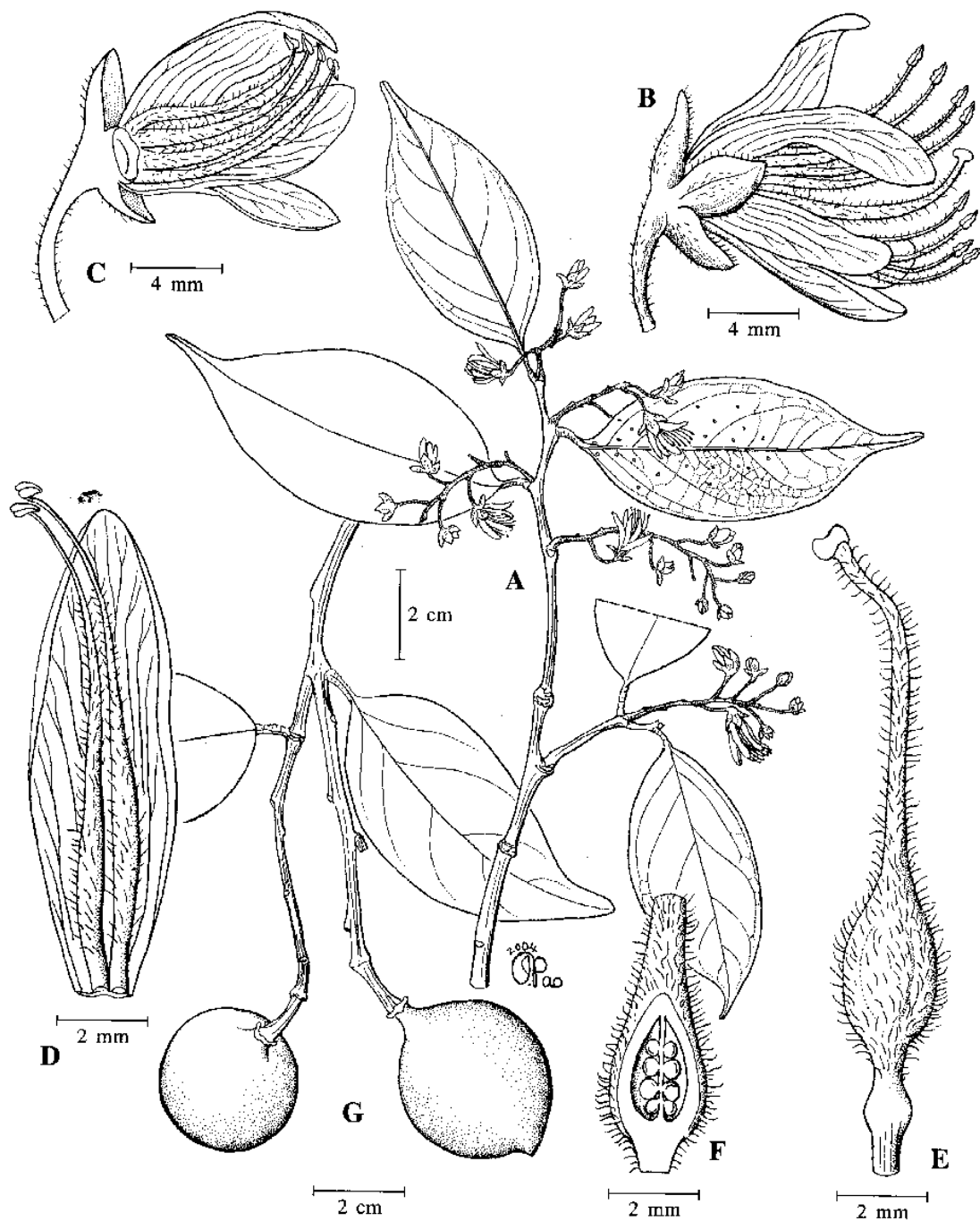


Fig. 13. *Xanthophyllum stipitatum*. A, flowering leafy twig; B, open flower; C, longitudinal section of open flower with the gynoecium removed; D, adaxial view of stamens and petal; E, gynoecium; F, longitudinal section of ovary; G, fruiting leafy twig. (A–F from SAN 66701, G from S 30045.)

44. *Xanthophyllum schizocarpon* Chodat

(Greek, *schizein* = to split, *karpos* = fruit; referring to the sulcate fruit)

(subgen. *Xanthophyllum*, sect. *Xanthophyllum*)

In Merrill, PEB (1929) 136; Masamune *op. cit.* 381; Anderson *op. cit.* (1980) 288; Meijden *op. cit.* (1982) 74, *op. cit.* (1988) 504. **Lectotype** (Meijden, 1982): *Elmer 21519*, Borneo, Sabah, Tawau (L; isolecotypes BM, BO, BR, C, G, K, M, P, SING, U, Z).

Tree, 10–25 m tall, to 35 cm diameter. **Bark** grey or brownish, smooth. **Sapwood** white. **Twigs** smooth, without nodal glands, minutely appressed short-hairy in younger parts or glabrous. **Axillary buds** in clusters of two or three, to 1 mm long, the upper one located up to 3 mm above the axil. **Leaves** more or less discolorous, glabrous, flat and greyish green above, dull glaucous or whitish, (mostly) papillose, often minutely appressed (or subpatently) short-hairy mainly on the veins below; blades lanceolate, 4.5–12(–14) × 1.5–4.5(–7) cm, base cuneate, apex acute-acuminate; midrib flat above; lateral veins 6–7 pairs, not forming an intramarginal vein; intercostal venation indistinct, scalariform; glands numerous, scattered, c. 0.2 mm diameter, basal glands (if present) c. 0.5 mm diameter; petioles 3–5(–8) mm long, minutely appressed hairy or glabrous, smooth, without glands. **Inflorescences** shorter than the leaves, often slightly supra-axillary, 1 or 2 per leaf axil, branched or unbranched, rather few-flowered; axes minutely appressed hairy; lower bracts opposite. **Flowers**: pedicels 6–8 mm long; outer sepals 2.5–4 mm long, inner sepals 3–4.5 mm long, more or less keeled; petals yellow, drying pale yellowish, the longest one 6–7 mm long, keel appressed hairy outside, short-hairy inside in apical part, other petals glabrous to short-hairy on both sides; *stamens* 8 (or 9), *filaments* free, anthers c. 0.3 mm long; *ovary* slightly ribbed, brownish, appressed hairy on median ribs or glabrous, stigma slightly 2-lobed, *ovules* 6–8. **Fruits** globose or depressed globose, c. 1.5 cm diameter, irregularly 4-sulcate or not, dull, pale greenish to yellowish brown; pericarp hard and sometimes irregular in thickness; fruiting pedicels 6–9 mm long, c. 3 mm thick. **Seed** 1.

Distribution. Endemic in Borneo (Sabah, Sarawak, and Kalimantan). In Sabah, known from Labuk Sugut, Ranau, Tambunan and Tawau (e.g., *SAN* 25303, *SAN* 36305, *SAN* 116377 and *SAN* 140151) and in Sarawak from Bau, Limbang, Miri and Tatau districts (e.g., *S* 21915, *S* 21964, *S* 40305, *S* 42931 and *S* 72976). In Kalimantan, the species is represented by two collections, one from G. Bentuang (*Burley et al.* 2547) and the other from Ulu Barito (*Ridsdale PBU* 284).

Ecology. Mixed dipterocarp forest on sandy banks or on basalt hillsides, at altitudes to 800 m.

Notes. *Xanthophyllum schizocarpon* is close to, but generally more delicate than the variable *X. flavescens*. The irregularly 4-sulcate fruits of the type specimen may be caused by gall wasps.

45. *Xanthophyllum stipitatum* A.W.Benn.

Fig. 13.

(Latin, *stipitatus* = stalked; the ovary)

(subgen. *Exsertum*)

In Hooker *f.*, Fl. Br. Ind. 1 (1874) 210; King *op. cit.* 140; Ridley *op. cit.* (1922) 145; Chodat *in* Merrill *op. cit.* (1929) 137; Masamune *op. cit.* 381; Ng *op. cit.* (1972) 363; Anderson *op. cit.* (1980) 288; Meijden *op. cit.* (1982) 142, *op. cit.* (1988) 535; Kessler & Sidiyasa *op. cit.* 194; Turner *op. cit.* 406; Coode *et al.* (eds.) *op. cit.* 257; Argent *et al.* (eds.) *op. cit.* 511; Beaman & Anderson *op. cit.* 266. **Type:** Maingay 140 (= Kew Distr. 3292), Malacca (holotype K; isotype K). **Synonyms:** *X. stipitatum* var. *borneense* Chodat *in* Merrill *op. cit.* (1929) 137; *X. stipitatum* var. *nitidum* Chodat *in* Merrill *op. cit.* (1929) 137, Masamune *op. cit.* 381; *X. stipitatum* var. *pachyphyllum* Chodat *in* Merrill *op. cit.* (1929) 137, Masamune *op. cit.* 381; *X. amoenum* Chodat, Bull. Herb. Boiss. 4 (1896) 259, Masamune *op. cit.* 379, Anderson, *op. cit.* (1963) 153, Ng *op. cit.* (1972) 356, Meijden *op. cit.* (1982) 141, *op. cit.* (1988) 533; **syn. nov.** **Lectotype** (Meijden, 1982): Haviland 2112, Sarawak, Kuching (K; isolectotype SAR).

Tree, rarely shrub, to 50 m tall, to 80 cm diameter, sometimes buttressed. **Bark** pale brown or grey, smooth. **Sapwood** (whitish) yellow. **Twigs** smooth, without nodal glands, glabrous. **Axillary buds** in clusters of 2(–4), the upper largest one c. 2 mm long. **Leaves** glabrous, flat and (dark) brown or reddish brown above, sometimes waxy and not papillose below; blades ovate-elliptical, (2.5–)4–14 × (1–)2–7 cm, base rounded or cuneate, apex (long) acute-acuminate, tip rounded; midrib sunken above; lateral veins 5–7 pairs, not forming an intramarginal vein, prominent or obscure; intercostal venation coarsely reticulate; glands 0–10(–20), scattered or located near the base and in the middle of the leaf, 0.1–0.5 mm diameter; petioles 3–10 mm long, finely transversely wrinkled, glabrous, without glands. **Inflorescences** unbranched, 6–14-flowered; axes finely hairy or subglabrous; bracts minute, caducous. **Flowers** drying black; pedicels 5–15 mm long, minutely woolly hairy; sepals densely minutely hairy on both sides or almost glabrous, outer sepals 2–3 mm long, inner sepals 3–4.5 mm long; petals subequal, 7–11(–12) mm long, white, the three lower ones with a yellow centre, dark when dry, glabrous outside, woolly hairy inside at base and apex; filaments free, 11–13(–16) mm long, short woolly hairy or glabrous in apical part, anthers c. 0.8 mm long, glabrous or with few hairs at base; ovary glabrous or densely woolly hairy, black when dry, stipitate, style woolly hairy or glabrous in upper half, ovules 8–16, stigma slightly 2-lobed. **Fruits** globose, 4–6(or more) cm diameter, sometimes sterile, short- or long-stipitate, black (yellow or orange when ripe), often bluish waxy, glabrous or sparingly hairy (glabrescent); pericarp smooth, (1–)5–15 mm thick; fruiting pedicels (5–)10–15 mm long, 2–4 mm thick. **Seeds** 4–12.

Vernacular names. Sabah—*lahal* (Dusun Tambunan), *tampasak* (Dusun Tambunan). Sarawak—*langir* (Iban), *nyalin paya* (preferred name).

Distribution. Sumatra, Peninsular Malaysia, Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah common and known from Beaufort, Keningau, Kinabatangan, Kota Kinabalu, Kudat, Labuk Sugut, Lahad Datu, Papar, Ranau, Sandakan, Sipitang, Tambunan, Tawau and Tenom districts (e.g., Clemens 31528, SAN 21635, SAN 25427, SAN 43685, SAN 66701 and SAN 73164). In Sarawak also common, recorded from Belaga, Bintulu, Kapit, Kuching, Lawas, Limbang, Lundu and Simunjan districts (e.g., S 15108, S 29641, S 32849, S 32960, S 43383 and S 50151). In Brunei, known from Belait, Temburong and Tutong districts (e.g., BRUN 5113, van Niel 4336, SAN 17422 and Smythies *et al.* 5846). In Kalimantan, recorded from several localities (e.g., Ambriansyah & Arifin W 259, bb. 18494, Kostermans 6712, Ridsdale & Sidiyasa PBU 665 and Wilkie 94324).

Ecology. Primary forest on hillsides or ridges, or along rivers, also peat swamp forest, at altitudes to 1500 m, on yellow sandy clay and brownish soils or soil over ultrabasic bedrock, occasionally also occurs in *kerangas* forest.

Notes. Ng (*op. cit.* 1972) and Meijden (*op. cit.* 1982, *op. cit.* 1988) recognized *Xanthophyllum amoenum* and *X. stipitatum* as two distinct but closely related species. Ng distinguished *X. stipitatum* from *X. amoenum* in having consistently smaller leaves, whereas Meijden segregated the two species based on the length of petals, hairiness of the style and ovary, number of leaf glands and thickness of the pericarp. In this Flora, and after examining more than 150 new collections from Borneo and Peninsular Malaysia, we adopted a broader species concept and recognised *X. stipitatum* (including *X. amoenum*) as a variable, widespread species.

Uses. The fruit pulp, of a sweetish sour taste, is recorded as edible; the pericarp is used for making shampoo (*S* 53900).

46. *Xanthophyllum subcoriaceum* (Chodat) Meijden

(Latin, *sub* = somewhat, *coriaceus* = leathery; the leaves)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Bot. J. Linn. Soc. 67 (1973) 120, *op. cit.* (1982) 85, *op. cit.* (1988) 509; Anderson *op. cit.* (1980) 288; Coode *et al.* (eds.) *op. cit.* 257; Beaman & Anderson *op. cit.* 266. **Basionym:** *X. ellipticum* Miq. var. *subcoriaceum* Chodat in Merrill *op. cit.* (1929) 134. **Lectotype** (Meijden, 1982): *Elmer* 21710, Borneo, Sabah, near Tawau (K; isoelectotypes BM, BO, BR, C, G, L, M, P, SING, U, Z).

Shrub or small tree, to 18 m tall and 20 cm diameter. **Bark** whitish or brownish, hard and smooth. **Sapwood** yellow. **Twigs** smooth, without nodal glands, slender, pale green, glabrous. **Axillary buds** in clusters of two (or three), (0.5–)1–2.5 mm long, glabrous. **Leaves** subcoriaceous, glabrous, sometimes slightly bullate between lateral veins and dull (pale) green above, yellowish green and not papillose below; blades elliptical, 5–12 × 1.5–5.5 cm, base cuneate, sometimes more or less rounded, margin sometimes curved upwards when dry, apex acuminate or cuspidate; midrib raised above; lateral veins (3–)4–6 pairs, mostly indistinct, forming a distinct intramarginal vein; intercostal venation usually obscure, reticulate; glands (0–)2–12, located at some distance from the midrib, 0.2–0.4 mm diameter; petioles 5–9 mm long, glabrous, finely wrinkled, without glands. **Inflorescences** shorter than or nearly as long as the leaves, mostly unbranched, (4–)6–12-flowered; axes sparsely hairy; lowermost bracts sometimes leaf-like. **Flowers:** pedicels 2–4 mm long, glabrous or sparsely appressed hairy; sepals (nearly) glabrous outside, outer sepals 1.6–1.8 mm long, inner sepals 2–2.5 mm long; petals white, drying orange, ciliate apically, outside glabrous except at base, longest one 8–10 mm long; filaments free, anthers 0.5–0.7 mm long, sparsely hairy at base; ovary 0.5–1.5 mm stipitate, glabrous or subglabrous, style sparsely appressed hairy, stigma slightly 2-lobed, ovules 4. **Fruits** at first with subpersistent style, globose, 1.5(–1.7) cm diameter, glabrous, smooth, pale green to brown, dull or shiny, sessile or c. 1.5 mm stipitate; pericarp thin; fruiting pedicels 3(–7) mm long. **Seed** 1.

Distribution. Endemic in Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah, recorded from Kinabatangan, Lahad Datu, Ranau and Tawau districts (e.g., *SAN* 25006, *SAN* 35873, *SAN* 40528, *SAN* 56244 and *SAN* 99855) and in Sarawak from Kapit, Kanowit and Miri districts (e.g., *S* 22229, *S* 23907, *S* 29199, *S* 41448 and *S* 57274). In Brunei, known by one collection (*BRUN* 737) from Temburong district and in C Kalimantan, recorded from few localities (e.g., *Mogea & de Wilde* 4240, *Mogea & de Wilde* 4269 and *Mogea & de Wilde* 4441).

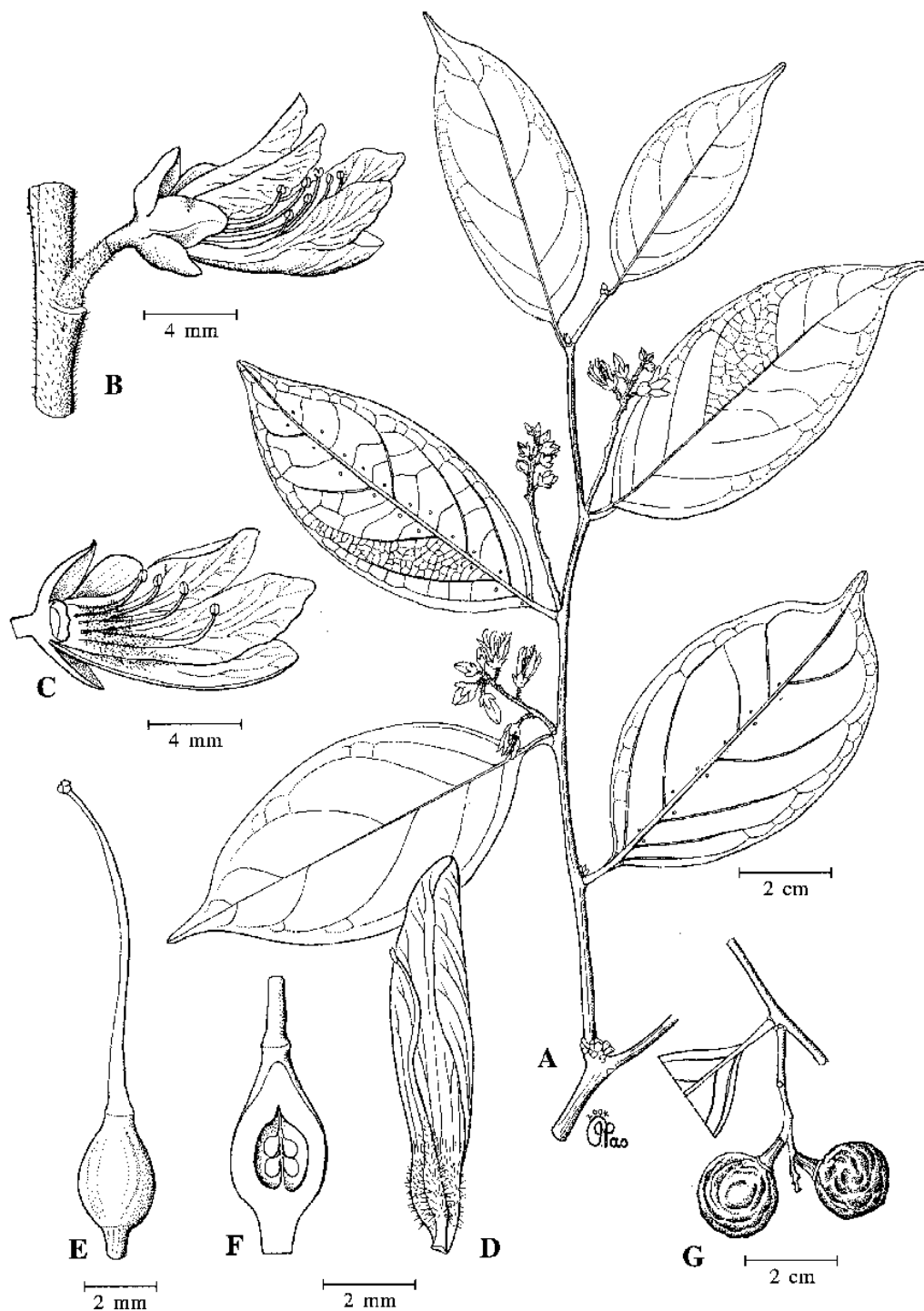


Fig. 14. *Xanthophyllum tenue*. A, flowering leafy twig; B, open flower; C, longitudinal section of open flower with the gynoecium removed; D, adaxial view of stamen and petal; E, gynoecium; F, longitudinal section of ovary; G, infructescence. (A–F from SAN 36153, G from SAN 61774.)

Ecology. Lowland swamp forest and mixed dipterocarp forest, on flat land, hillsides or ridges, on yellow sandy clay soil, at altitudes to 700 m.

Notes. *Xanthophyllum subcoriaceum* closely resembles *X. neglectum* and *X. tenue*. Without examining the indumentum of the ovary and/or fruit, it is difficult to distinguish the three species. The ovaries and/or fruits are conspicuously hairy in *X. neglectum* and glabrous in *X. tenue*. In *X. subcoriaceum*, on the other hand, glabrous as well as finely hairy ovaries/fruits seem to occur. The distinction of the three species needs further study.

47. *Xanthophyllum tardicrescens* Meijden

(Latin, *tarde* = slowly, *crescens* = growing; the twigs)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Bot. J. Linn. Soc. 67 (1973) 120, *op. cit.* (1982) 87, *op. cit.* (1988) 510; Anderson *op. cit.* (1980) 288. **Type:** Anderson *et al.* S 24331, Borneo, Sarawak (holotype L; isotypes K, KEP, SAN, SAR).

Treelet, to 6 m tall, to 6 cm diameter. **Twigs** smooth, without nodal glands, yellow-green, glabrous, bearing 2 (or 3) leaves per shoot. **Axillary buds** in clusters of 2 (or 3), shorter than 1 mm. **Leaves** glabrous, flat and green above, greenish, dull and not papillose below; blades narrowly elliptical, 7–16(–17) × 2–5(–7) cm, base rounded-truncate or cordate, apex long-acuminate with rounded tip; midrib prominent above; lateral veins 3–4 pairs, slightly sunken above, the basal veins long, reaching often beyond the middle of the leaf, or forming an intramarginal vein; intercostal venation indistinct, reticulate; glands 6–12, scattered, 0.2–0.3 mm diameter; petioles 3.5–5 mm long, glabrous, hardly wrinkled or finely transversely wrinkled, without glands. **Inflorescences** as long as or shorter than the leaves, unbranched; axes nearly glabrous; flowers often in clusters of 2 or 3; bracts late-caducous. **Flowers:** pedicels 3–4 mm long, sparsely appressed hairy; sepals sometimes with glandular spots at apex, outer sepals c. 2 mm long, inner sepals c. 2.5 mm long; petals white, the upper ones with a yellow spot, drying yellowish orange, the longest one 7–8 mm long, keel nearly glabrous outside, other petals glabrous; filaments connate for 0.7–1 mm, short hairy above base, for the rest glabrous, anthers c. 0.7 mm long; ovary short stipitate, more or less appressed hairy all around, stigma slightly 2-lobed, ovules 4. **Fruits** (immature) globose, smooth, somewhat shiny, yellowish green, sparsely appressed hairy all around, glabrescent; pericarp thin; fruiting pedicels c. 4 mm long. **Seed** 1.

Distribution. Endemic in Borneo (Sarawak and Brunei). In Sarawak, recorded from Semengoh FR, Kuching district (e.g., S 3390, S 14948 and S 24331) and in Brunei, known by two rather doubtful collections (BRUN 3642 and BRUN 15587) from Belait and Temburong districts, respectively.

Ecology. Mixed dipterocarp forest.

Notes. *Xanthophyllum tardicrescens* is reminiscent of *X. pauciflorum*, *X. neglectum* and *X. subcoriaceum* but the latter three species differ in having a cuneate (not truncate or cordate) leaf base. The leaf shape of *X. tardicrescens* is similar to that of *X. purpureum*, but in the latter the leaves are hairy and papillose below.

48. **Xanthophyllum tenue** Chodat

Fig. 14, Plate 8B.

(Latin, *tenuis* = slender, thin; the twigs)

(subgen. **Xanthophyllum**, sect. **Eystathes**)

In Merrill, PEB (1929) 135; Masamune *op. cit.* 382; Anderson *op. cit.* (1980) 288; Meijden *op. cit.* (1982) 83, *op. cit.* (1988) 508; Argent *et al.* (eds.) *op. cit.* 511; Beaman & Anderson *op. cit.* 266.

Type: *Elmer* 21355, Borneo, Sabah, near Tawau (holotype G; isotypes BM, BO, BR, C, G, K, L, M, P, SAN, SING, U, Z).

Treelet or tree, 3–25 m tall, to 20(–40) cm diameter. **Bark** greyish or pale brown, smooth or scaly. **Sapwood** yellowish. **Twigs** smooth, without nodal glands, glabrous to patently short-hairy. **Axillary buds** in clusters of two (or three), 1.5–2.5 mm long, (sparsely) minutely hairy, sometimes irregularly shaped, and larger because of cork-formation in apical region. **Leaves** slightly bullate or flat between lateral veins and green or brown-green above, pale green or yellowish green, not papillose, glabrous or minutely patently hairy below; blades (narrowly) elliptical, (5–)7–16 × (2–)2.5–6.5 cm, base cuneate, apex long-acuminate; midrib glabrous or patently minutely hairy in basal half, slightly raised to flat above; lateral veins 4–6 pairs, forming an indistinct intramarginal vein; intercostal venation reticulate (or subscalariform), indistinct or slightly prominent; glands (0–)4–25, mostly located near midrib, 0.3–0.7 mm diameter, basal glands often present; petioles 6–11 mm long, smooth, patently short-hairy or glabrous, glands absent or small. **Inflorescences** much shorter than the leaves, unbranched, 5–8-flowered; axes short-hairy. **Flowers:** pedicels 2–6(–10) mm long, short-hairy; sepals nearly glabrous outside, outer sepals 2–3 mm long, inner sepals 2.5–4.5 mm long; petals yellowish or white, drying orange, the longest one 8–9(–11) mm long, keel sparsely to densely appressed hairy on both sides, other petals glabrous to (sparsely) hairy; filaments connate for up to 1.5 mm, anthers c. 0.4 mm long; ovary glabrous (rarely sparsely appressed hairy, soon glabrescent), 0.5–1 mm stipitate, style glabrous or sparsely appressed hairy in basal part, early falling, stigma slightly 2-lobed, ovules 4. **Fruits** globose, 1.2–1.9 cm diameter, glabrous, dull, wrinkled, pale greenish brown; pericarp soft, thin; fruiting pedicels 2–7(–10) mm long, c. 2 mm thick. **Seeds** 1 or 2.

Distribution. Endemic in Borneo (Sabah, Sarawak and Kalimantan). In Sabah, recorded from Keningau, Kota Belud, Ranau, Tambunan and Tawau (e.g., *SAN* 29512, *SAN* 36153, *SAN* 42451, *SAN* 65335 and *SAN* 91655) and in Sarawak from Belaga, Kapit, Lubok Antu and Marudi districts (e.g., *Burt* 4935, *Nooteboom & Chai* 1755, *S* 39793, *S* 43632 and *S* 57274). In Kalimantan, known by few collections from W, C and E parts (e.g., *Endert* 3674, *Kato et al.* *B* 9361, *Nooteboom* 4685 and *Wiriadinata et al.* *ITTO/BB* 214).

Ecology. Mixed dipterocarp forest and lower montane forest, on riverbanks or hillsides, at altitudes to 1500 m.

49. **Xanthophyllum trichocladum** Chodat

Fig. 15.

(Greek, *tricho* = hairy, *klados* = twig; the hairy twigs)

(subgen. **Xanthophyllum**, sect. **Eystathes**)

In Merrill, PEB (1929) 137; Masamune *op. cit.* 382; Meijden *op. cit.* (1982) 115, *op. cit.* (1988) 523.

Lectotype (Meijden, 1982): *Elmer* 21549, Borneo, Sabah, near Tawau (L; isolectotypes BM, BO, BR, C, G, K, M, P, SING, U, Z).

Shrub or small tree, 12(–18) m tall, to 25 cm diameter. **Bark** whitish or yellowish grey, smooth. **Sapwood** white or yellowish. **Twigs** *without nodal glands, densely patently yellow-brown long-hairy*, hairs *c.* 1 mm long. **Axillary buds** *solitary, ovate-oblong*, (1.5–)2.5–5(–6) mm long, densely hairy. **Leaves** *discolorous, flat*, green and hairy on the midrib *above*, *papillose and densely patently long-hairy all over below*; blades *narrowly elliptical*, 11–31 × 3–9 cm, base *cordate*, sometimes covering upper side of petiole, apex *subacute*; midrib sunken or flat; lateral veins 9(–12) pairs, forming a distinct intramarginal vein; intercostal venation *reticulate*; glands numerous, scattered, *c.* 0.1 mm diameter; petioles 4–7 mm long, densely patently long-hairy, smooth, without glands. **Inflorescences** shorter than or as long as the leaves, *unbranched* (or sometimes with one side-branch at very base); axes with dense brown patent hairs 0.5–1 mm long. **Flowers**: pedicels 3–7 mm long; sepals densely brown hairy outside (hairs to 1 mm long), outer sepals 3 mm long, inner sepals 3.5–4(–5) mm long; petals pink, the upper ones with a yellow spot, drying dark reddish, the longest one 13(–16) mm long, keel glabrous to appressed hairy outside along central veins, other petals (sub)glabrous or sparsely ciliate at base; filaments free or to 1.5 mm connate, anthers 2–3 mm long, faintly hairy at base, ciliolate along slits; ovary patently hairy, stigma slightly 2-lobed, ovules 11–16. **Fruits** globose, *c.* 1.5 cm diameter, densely hairy; pericarp thin; sepals subpersistent; fruiting pedicels 4–7 mm long, *c.* 2.5 mm thick. **Seed** 1.

Vernacular name. Sabah—*bongkulat* (Dusun Kinabatangan).

Distribution. Endemic in Borneo (Sabah, Sarawak and Kalimantan). In Sabah common, recorded from Kinabatangan, Labuk Sugut, Lahad Datu, Sandakan, Tambunan and Tawau districts (e.g., *SAN 35929*, *SAN 38119*, *SAN 76752*, *SAN 89870* and *SAN 130727*) and in Sarawak from Kapit and Kuching districts (e.g., *S 29694*, *S 37695*, *S 66089* and *Whitmore 8413*). In E Kalimantan, rare and collected once (*Kostermans 6582*) from Loa Djanan.

Ecology. Mixed dipterocarp forest, on flatland, hillsides or near streams, at altitudes to 500 m.

50. *Xanthophyllum velutinum* Chodat

(Latin, *velutinus* = velvety; referring to the twig and leaf lower surface)

(subgen. *Xanthophyllum*, sect. *Xanthophyllum*)

Bull. Herb. Boiss. 4 (1896) 259; Merrill *op. cit.* (1921) 326; Masamune *op. cit.* 382; Meijden *op. cit.* (1982) 75, *op. cit.* (1988) 505; Coode *et al.* (eds.) *op. cit.* 257; Argent *et al.* (eds.) *op. cit.* 514; Beaman & Anderson *op. cit.* 267. **Type:** *Beccari 1629*, Borneo, Sarawak (holotype K; isotypes FI, G, P, W).

Tree, 5–25 m tall, to 20 cm diameter. **Bark** pale brown or grey, smooth or longitudinally fissured. **Sapwood** whitish or yellowish. **Twigs** *smooth, without nodal glands, densely set with short and long grey or brown hairs 0.3–1 mm long*. **Axillary buds** *solitary*, 1–3 mm long, hairy like the twig. **Leaves** *sometimes discolorous, flat*, greyish green, in basal part sometimes sparsely hairy especially on the veins and midrib *above*, *brownish, not or indistinctly papillose and densely (or sparsely) hairy like the twig below*; blades *narrowly elliptical to elliptical*, (6–)9–22 × 3–9 cm, base *cuneate* or rounded, apex *acuminate* or *cuspidate*; midrib, veins and intramarginal vein slightly sunken or flat and mostly obscure above; lateral veins 8–11(–12) pairs, strongly prominent, forming a prominent intramarginal vein; intercostal venation *scalariform*; glands (7–)10 or more, scattered, 0.2–0.6 mm diameter, basal glands *c.* 1 mm diameter; petioles (4–)8–14(–16) mm long, smooth, hairy like the twig, without glands. **Inflorescences** about as long as or shorter than the

leaves, *branched* (exceptionally unbranched); axes densely patently brownish hairy in the basal part; flowers often in clusters of 3. **Flowers:** pedicels 1.5–7 mm long, densely (brown) hairy; sepals greyish hairy, outer sepals 2–3 mm long, with 2–4 glandular spots, inner sepals 3.5–5 mm long, keeled; petals white or yellow, drying brownish orange, the longest one 9–11 mm long, keel appressed hairy outside, sparsely hairy inside in middle part, other petals ciliate in basal half, glabrous outside, upper petals reflexed; *filaments free*, sparsely appressed hairy, anthers *c.* 1 mm long, usually cohering around the stigma, ciliate along slits; *ovary* sessile, ribbed, *glabrous or at apex hairy on 2 ribs down to halfway*, style reflexed at end of anthesis, hairy, *stigma slightly 2-lobed*, *ovules (4–)8–12*. **Fruits** often *with persistent sepals*, broadly ovoid, 2–2.5 cm diameter, beaked, sometimes with *c.* 8 ribs, *glabrous*, finely pustulate to tuberculate, dull brown; pericarp thick, hard; fruiting pedicels 2–7 mm long, *c.* 3 mm thick. **Seed** 1.

Vernacular name. Sabah—*ansarapak* (Dusun).

Distribution. Endemic in Borneo (Sabah, Sarawak, Brunei and Kalimantan). In Sabah common, known from Keningau, Kinabatangan, Lahad Datu, Pensiangan, Pitas, Sandakan, Tawau and Tenom districts (e.g., *SAN 31915*, *SAN 43153*, *SAN 58756*, *SAN 64765*, *SAN 118648*, *SAN 120327* and *SAN 121263*) and in Sarawak from Bintulu, Kapit, Kuching, Lundu, Marudi, Miri and Samarahan districts (e.g., *S 21514*, *S 37041*, *S 40071*, *S 41591* and *S 43429*). In Brunei, recorded from Belait and Tutong districts (e.g., *BRUN 16536*, *BRUN 16777*, *Dransfield et al. JD 7273* and *SAN 17537*). In E Kalimantan, known from few collections (e.g., *Ambriansyah AA 785* and *Kessler et al. 311*).

Ecology. Mixed dipterocarp or old secondary forest and riverine forest or lower montane forest, commonly on ridges or hillslopes, on clay or sandy soils, also on ultrabasic bedrock, at altitudes to 900 m.

51. *Xanthophyllum vitellinum* (Blume) D.Dietr.

(Latin, *vitellinus* = egg-yolk yellow; referring to the colour of the petals)

(subgen. *Xanthophyllum*, sect. *Eystathes*)

Syn. Pl. 2 (1840) 1277; Chodat *op. cit.* (1891) *t.* 9, f. 1–2, *t.* 12, f. 4 c–e; Merrill *op. cit.* (1921) 326; Masamune *op. cit.* 382; Backer & Bakhuizen *f. op. cit.* 200; Meijden *op. cit.* (1982) 97, *op. cit.* (1988) 514; Turner *op. cit.* 406; Argent *et al.* (eds.) *op. cit.* 514; Pendry *op. cit.* 537; Beaman & Anderson *op. cit.* 267. **Basionym:** *Jakkia vitellina* Blume, Cat. Gew. Buitenzorg (1823) 17, 64, *op. cit.* (1825) 61 (*‘Jakkia’*). **Lectotype** (Meijden, 1982): *Anonymous (Blume?) s.n.*, Java (L [Acc. No. 90817256]; isolectotypes AMD [Acc. No. 036929], BO, L [Acc. Nos. 90817262, 90817263, 90817270 & 925250351], MEL, U [Acc. Nos. 40574 & 40575]). **Synonyms:** *Jakkia longiflora* Blume *op. cit.* (1825) 61; *X. longifolium* (Blume) D. Dietr. *op. cit.* 1277; *X. paniculatum* Miq. *op. cit.* (1861) 393; *X. hookerianum* King *op. cit.* 139, Ridley *op. cit.* (1922) 144, Ng *op. cit.* (1972) 359; *X. kunstleri* King *op. cit.* 139, Ng *op. cit.* (1972) 359; *X. curtisii* King *op. cit.* 138, Ridley *op. cit.* (1922) 146; *X. griffithii* var. *curtisii* (King) Ng *op. cit.* (1972) 359; *X. robustum* Chodat, Bull. Herb. Boiss. 4 (1896) 262, Merrill *op. cit.* (1921) 326, *op. cit.* (1923) 387, Masamune *op. cit.* 381; *X. robustum* var. *elmeri* Chodat in Merrill *op. cit.* (1929) 136, Masamune *op. cit.* 381.

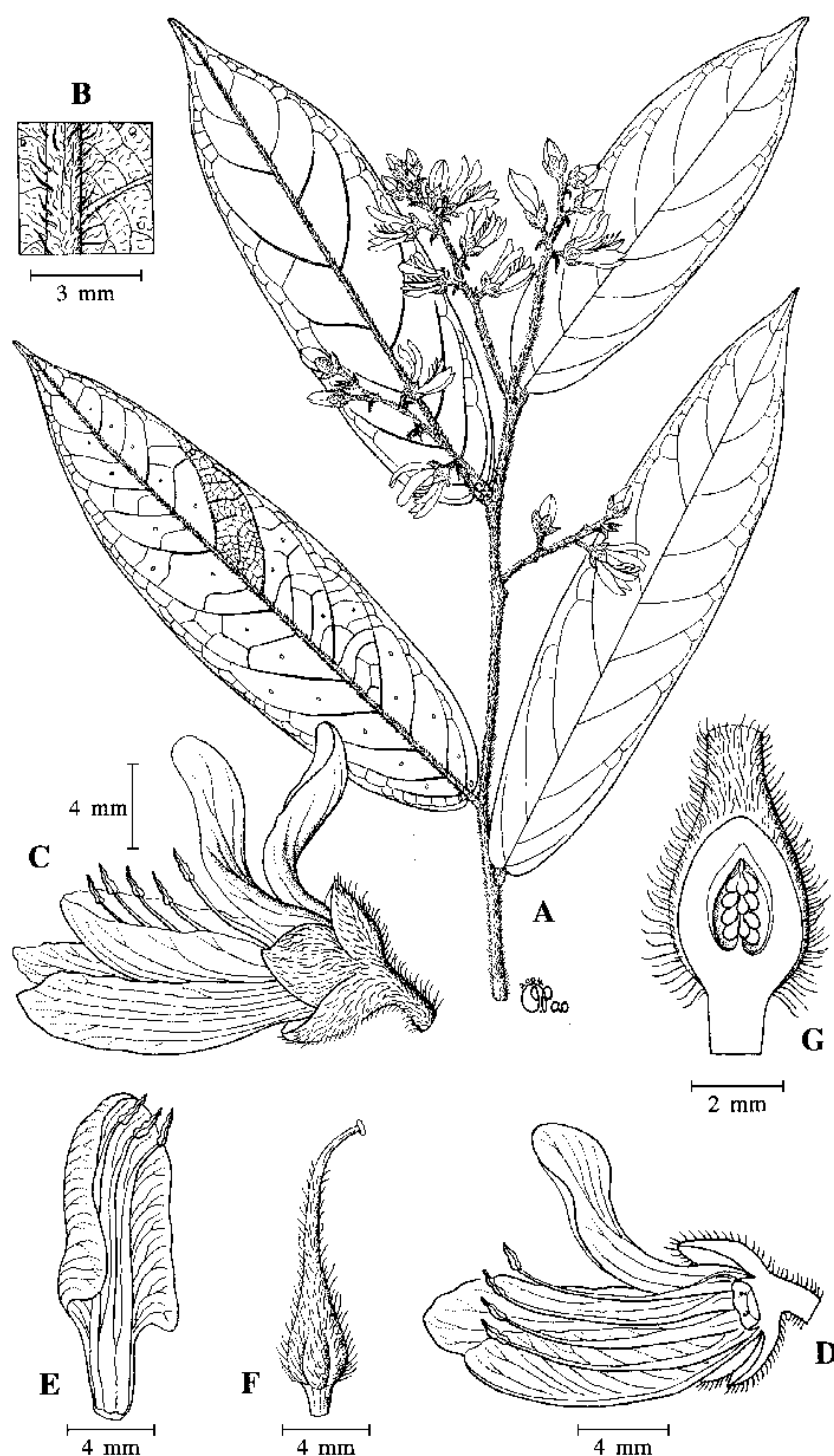


Fig. 15. *Xanthophyllum trichocladum*. A, flowering leafy twig; B, detail of lower leaf surface with indumentum and glands; C, open flower; D, longitudinal section of open flower with the gynoecium removed; E, adaxial view of stamens and petal; F, gynoecium; G, longitudinal section of ovary. (All from S 37695.)

Shrub, treelet or tree, to 25 m tall and to 40 cm diameter. **Bark** whitish or greyish brown, smooth, lenticellate. **Sapwood** yellowish. **Twigs** smooth, stout, 2–3 mm diameter, glabrous, without nodal glands. **Axillary buds** solitary, not appressed to the twig, varying from narrowly triangular with thickened base, 1.5–3 mm long, to rhomboid-ovate or ovate-oblong and then often 6–11 mm long, variously hairy. **Leaves** membranous or subcoriaceous, glabrous, flat and green to (dark) brown above, not papillose below; blades (narrowly) elliptical, 6–20(–30) × 2.5–11 cm, base cuneate, apex acute-acuminate; midrib prominent or nearly flat in basal half above; lateral veins (6–)7–9(–11) pairs, in apical half forming an indistinct intramarginal vein; intercostal venation coarsely reticulate, areoles subequal or unequal in size 1–5 mm diameter; glands mostly more than 10, located near midrib or scattered, 0.2–0.4 mm diameter, basal glands mostly present; petioles 8–14(–16) mm long, glabrous, smooth or finely transversely wrinkled, often with a pair of glands in apical half. **Inflorescences** 8–30 cm long, branched; axes often in pairs in lower part, glabrous or patently or appressed short-hairy, in basal part flowers in clusters of up to 3, solitary in apical part; lower bracts nearly opposite. **Flowers:** pedicels 1.5–6 mm long; sepals basally often somewhat thickened and wrinkled, outer sepals 2–3.5 mm long, inner sepals (2.5–)3–5.5 mm long; petals yellow or white, drying orange to dark reddish (blackish) and often with white incrustations, the longest one 7–12(–15) mm long, keel appressed hairy outside, other petals glabrous outside or with a few hairs at apex; stamens 8 (or 9), filaments free (or connate to 1 mm), widened above base and with a knob-like hairy appendage at inner side, for the rest glabrous, anthers 0.4–0.6(–0.7) mm long; ovary to 1 mm stipitate, half-patently hairy all around, style largely hairy, stigma slightly 2-lobed, ovules 4. **Fruits** globose, (1.5–)1.8 cm diameter, often wrinkled when dry, dull or shiny, pale or dark brown(-green), hairy or glabrescent all around; pericarp rather thin; fruiting pedicels 3–6 mm long, c. 2 mm thick. **Seed** 1.

Vernacular names. Sabah—*turupok* (Dusun). Sarawak—*sabetong* (Kayan), *sambubu* (Malay).

Distribution. Thailand, Sumatra, Peninsular Malaysia, Java, Borneo (Sabah, Sarawak and Kalimantan) and the Philippines. One of the most common species. In Sabah, recorded from Beaufort, Keningau, Kinabatangan, Kota Belud, Kota Marudu, Labuk Sugut, Lahad Datu, Penampang, Ranau, Sandakan, Tambunan, Tawau and Tenom districts (e.g., *SAN 17307*, *SAN 28610*, *SAN 36387*, *SAN 41483*, *SAN 91919* and *SAN 129970*) and in Sarawak from Belaga, Kapit and Lubok Antu districts (e.g., *Haviland 2835*, *S 23996*, *S 43459*, *S 46723* and *S 67266*). In Kalimantan known by several collections (e.g., *Ambriansyah et al. AA 253*, *bb. 12229*, *bb. 13881*, *Endert 5181* and *Mogea et al. 3489*).

Ecology. Mixed dipterocarp forest, riverine forest or lower montane forest, on flatland, hillsides or ridgetops, on brown soil, black sandy soil or sandy clay soil, occasionally on ultrabasic bedrock, at altitudes to c. 800 m.

52. *Xanthophyllum* sp. A

Plates 8C–D.

(subgen. *Xanthophyllum*, sect. *Eystathes*)

The specimens representing this taxon have been collected from slender trees, 3–7(–12) m tall, growing in stunted forest on ultrabasic soil at 400–700 m altitudes. The leaves are drying greenish, thickly coriaceous, ovate-elliptical, with a blunt apex and 4–7 pairs of faint

(on both surfaces) lateral veins. The inflorescences are unbranched, slender, 2–5 cm long and 4–10-flowered. The petals are creamy with the upper ones having a yellow blotch. The fruits are globose, *c.* 1 cm diameter and short-hairy.

Notes. Based primarily on its unbranched, slender inflorescences, *Xanthophyllum* sp. A keys out close to *X. neglectum* and *X. rectum*. It differs from the latter species, however, in having greenish (on drying), thickly coriaceous leaves with a blunt apex and faint lateral veins (on both surfaces).

Specimens examined. BORNEO—Sabah, Lahad Datu district, G. Silam (*SAN 98132*, *SAN 98164*, *SAN 98176*, *SAN 100814* and *SAN 100981*); Kinabatangan district, Imbak (*SAN 138170*); Keningau district, Nabawan FR (*SAN 139139*). PHILIPPINES—Palawan Islands (*SMHI 2153*, doubtful record).

53. *Xanthophyllum* sp. B

(subgen. *Xanthophyllum*, sect. *Eystathes*)

This taxon resembles *Xanthophyllum vitellinum* but differs in its globose, 2–3 mm diameter, glabrous axillary buds which are wrinkled on drying. Its leaves are smaller, 5–8 cm long, thinly coriaceous with hardly visible lateral veins and intercostal venation.

Specimens examined. BORNEO—Sarawak, Kapit district, Bt. Raya (*S 23996*); Sri Aman district, Sg. Engkari (*S 69725*).

54. *Xanthophyllum* sp. C

(subgen. *Xanthophyllum*, sect. *Eystathes*)

On account of its slender and unbranched inflorescence, this taxon also keys out close to *X. neglectum*. Taxonomically, however, *Xanthophyllum* sp. C is closely related to *X. vitellinum*. It differs from the latter in its unbranched inflorescence, glabrescent fruits which turn black on drying, yellowish green leaves with a subattenuate base, and sharply defined intercostal venation with the finer areoles more regular in size and shape. On account of its fine intercostal venation, this taxon also comes close to *X. nitidum*.

Specimens examined. BORNEO—Sabah, Labuk Sugut district, Bt. Meliau (*SAN 39311*), Sg. Meliau (*SAN 99667*), Sg. Tinumbukan (*SAN 90482*); Sandakan district, Bt. Malawati (*SAN 46638*), Bt. Takunan (*SAN 92417*).

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MNDT-CK

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MDB

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MDBS

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PMK

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FTSB

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EPMP

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TNB

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OFMSP

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TFPF

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PB

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EPB

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EB

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MDFB-LHW

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MFFSS

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FMP

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FMK

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CLS

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COMMONLY USED ABBREVIATIONS FOR LOCALITIES

English		Malay	
Word	Abbreviation	Word	Abbreviation
Central	C	Batang	Btg.
Division	Div.	Bukit	Bt.
East	E	Gunung	G.
Forest Reserve	FR	Kampung	Kg.
Hectare	ha	Sungai	Sg.
Island	Is.	Tanjung	Tg.
Mountain	Mt.		
National Park	NP		
North-East	NE		
North-West	NW		
River	R.		
South	S		
South-East	SE		
South-West	SW		
West	W		

PLATES

R.C.K. Chung



S.N. Phoon



S.N. Phoon

R.C.K. Chung



Plate 1. Cunoniaceae. *Weinmannia fraxinea*: A, habit; B, stipules; C, apical bud showing a continuous growth and producing a pair of young leaves; D, seedling on the forest floor.



C.M. Pannell



C.M. Pannell



C.M. Pannell

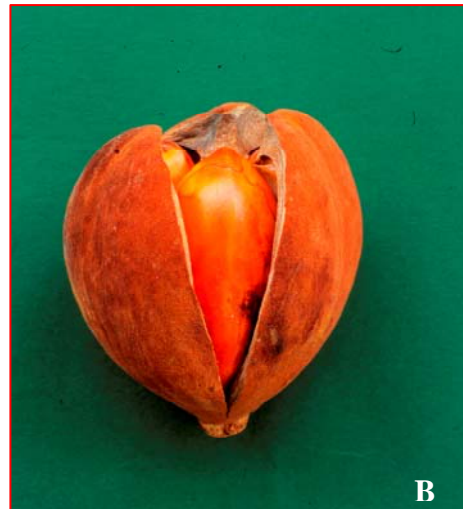


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Plate 2. Meliaceae. A, part of bole and outer bark of *Aglaia beccarii*; B, lower leaf surface of *A. densisquama*; C, longitudinal (above) and cross (below) sections of fruits of *A. forbesii* showing arillate seeds; D, fruiting leafy twigs of *A. glabrata*.



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Plate 3. Meliaceae. A–C, *A. macrocarpa*: A, fruiting leafy twigs, B, dehiscent ripe fruit showing arillate seeds, C, fruiting (young) leafy twig; D, leafy twig of *A. meliosmoides*.



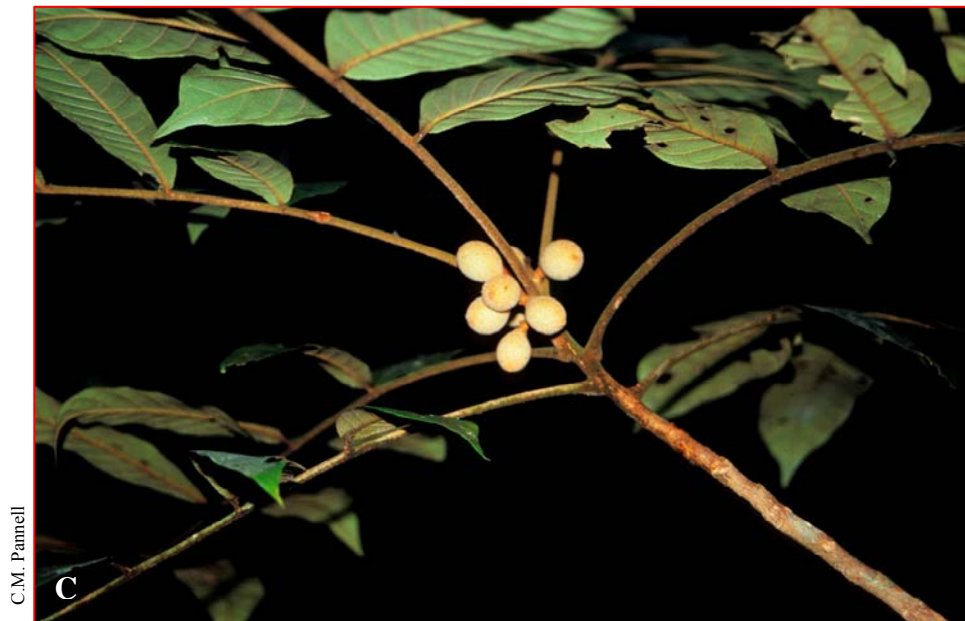
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A



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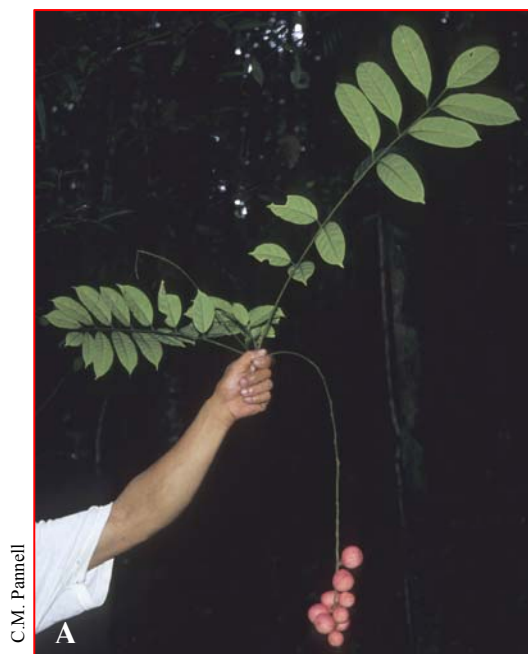
B



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C

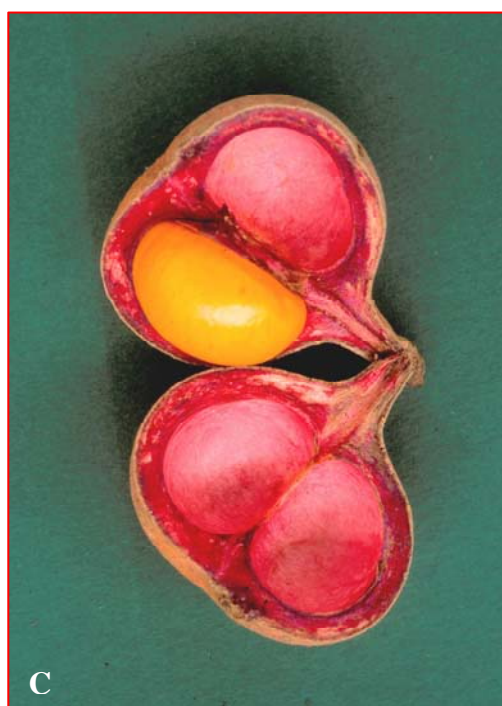
Plate 4. Meliaceae. A–B, *A. rufibarbis*: A, leafy twig, B, flowering leafy twig; C, fruiting leafy twig of *A. tomentosa*.



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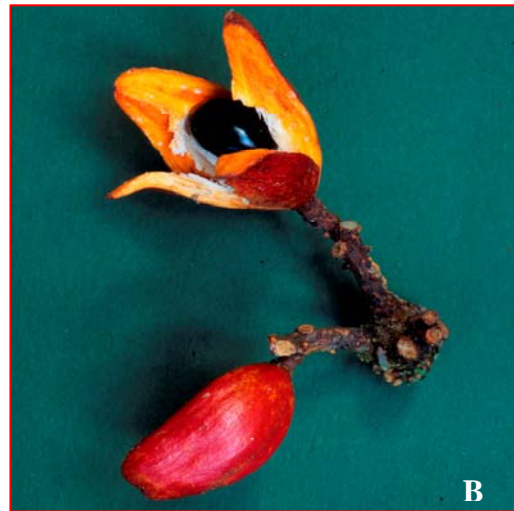
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Plate 5. Meliaceae. A, fruiting leafy twig of *Aphanamixis borneensis*; B, flowering leafy twig of *Chisocheton erythrocarpus*; C, dehiscent ripe fruit of *C. erythrocarpus* showing arillate seeds; D, fruiting leafy twig of *Chisocheton lansiifolius*.



C.M. Pannell

A



C.M. Pannell

B



E. Soepadmo

C



E. Soepadmo

D



E. Soepadmo

E

Plate 6. Meliaceae. A–B, fruits of *Dysoxylum cauliflorum*; C, fruits of *Lansium domesticum*; D, flowering leafy twig of *Xylocarpus granatum*; E, fruit of *X. granatum*.

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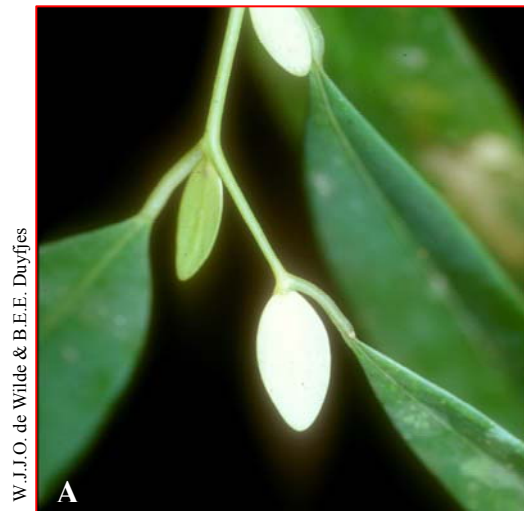
C

W.J.J.O. de Wilde & B.E.E. Duyfjes



D

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(compiled by S. Julia, H.S. Tan & O. Zainun)

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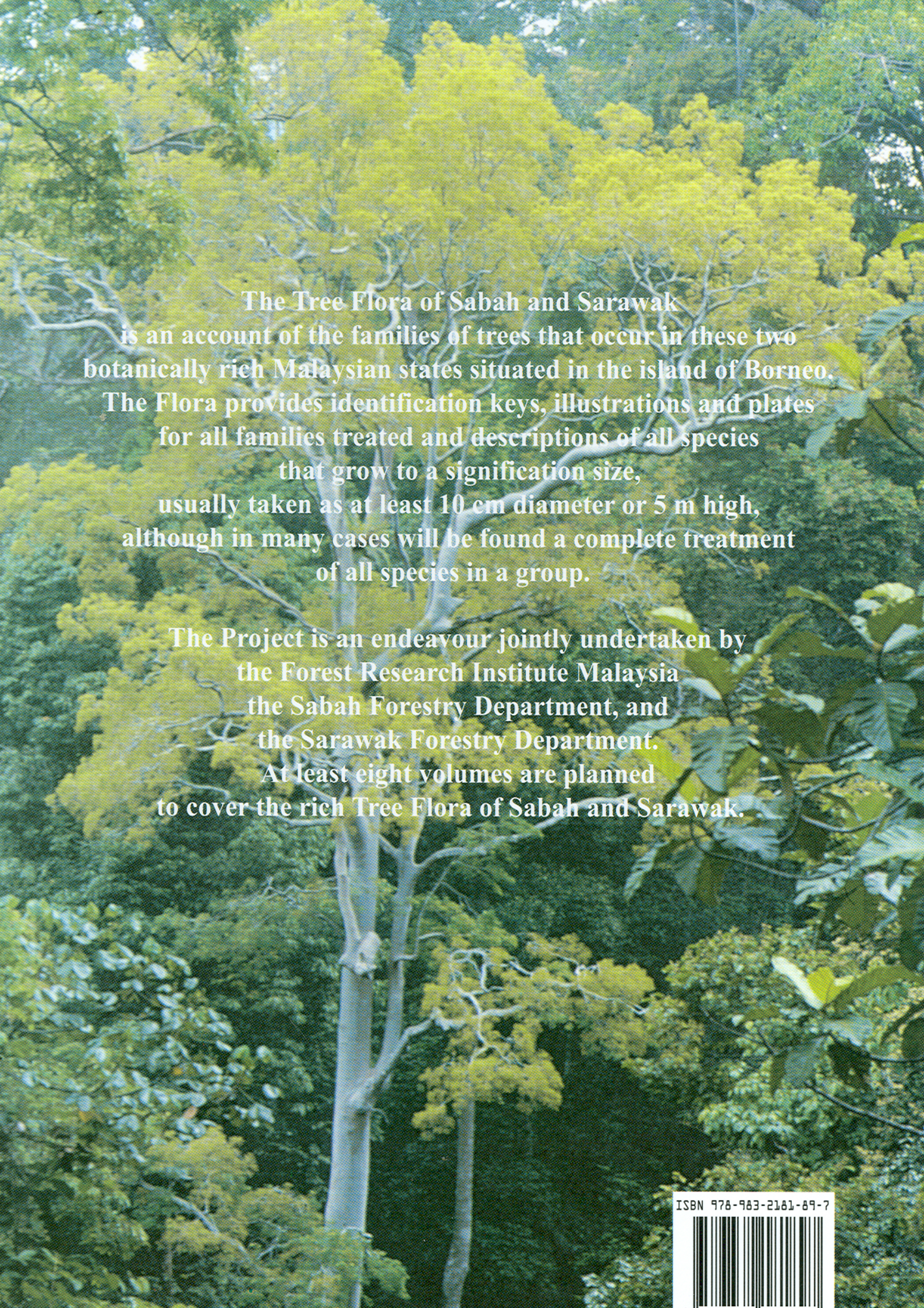
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The Tree Flora of Sabah and Sarawak
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